

Soil Survey

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Orleans County New York

By

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SOIL SURVEY OF ORLEANS COUNTY, NEW YORK

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COUNTY SURVEYED

Orleans County borders Lake Ontario in the northwestern, or up-State, section of New York (fig. 1). Albion, the county seat, is about midway between Rochester and Buffalo. The county is rectangular in shape.

The distance across it from east to west is 24 miles, and from north to south is about 17 miles. The total area is 396 square miles, or 253,440 acres.

A lowland belt of country, divided into several plains, extends east and west across the county. The plains are separated from each other by more or less definite ridges, slopes, or changes in elevation.

The northern part of the county comprises a moderately flat or undulating plainlike area which is a section of the Ontario plain. It has no abrupt or sudden changes in relief. The shore line bordering Lake Ontario is fairly even, with no bays or deep indentations. Along the edge of the lake there is an abrupt bluff rising from the lake shore to the plain, which ranges from 5 to 40 feet in height, and this is bordered by a narrow gravel beach, ranging from 10 to about 25 feet in width, that extends from the foot of the bluff to the water's edge. The southern edge of the lake plain terminates at the foot of a well-defined narrow gravelly sandy ridge extending across the county and into adjoining counties to the east and west. This ridge marks a shore line of a former glacial body of water known as Lake Iroquois which was an expanded or enlarged part of the present Lake Ontario. The ridge ranges in height from about 8 to about 30 feet. In many places the slope on both sides of the

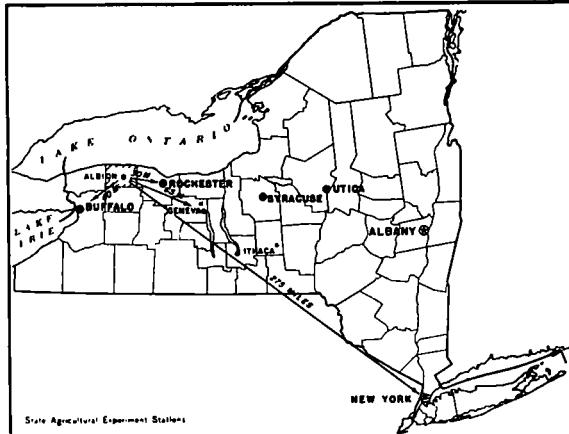


FIGURE 1.—Sketch map showing location of Orleans County, N. Y.

ridge is equal, but in some localities the top of the ridge merges with a higher plain or undulating upland. The ridge lies from about 6 to 8 miles south of Lake Ontario and divides the county into nearly equal parts, the total area north of the ridge being only about 10 percent smaller than that south of it.

A second plain south of the ridge is characterized by flat or gently undulating relief, and it ranges from about 4 to 6 miles in width. In parts of Ridgeway Town, the relief is featured by several comparatively smooth small benches rising from one level to another.

The upper or highest plain is undulating or gently rolling, with some included belts of flat land. The elevation increases gradually southward. The relief, in general, is more uneven in this part of the county than elsewhere. The northern boundary of this plain, entering from Niagara County, extends nearly east along the northern parts of Shelby and Barre Towns and thence south and east through Clarendon Town. In Shelby and Clarendon Towns it is marked by a steep slope, but in Barre Town the division is not everywhere pronounced. Along the southern boundary is a long narrow belt of flat land with small narrow fingerlike projections extending into the hilly area. A large area of the lower part of this belt is saturated with water or subject to inundation during some season of the year.

The elevation of the plateau or plain in the northern part ranges from the level of Lake Ontario, which is 246 feet above sea level, to about 400 feet at the foot of the ridge. The top of the ridge ranges from about 409 to 432 feet. From here elevations increase gradually southward to about 600 or more feet. The highest elevations recorded are 681 feet a short distance southwest of East Shelby, 700 feet near South Barre, and 737 feet north of West Barre.

Drainage is into Lake Ontario which receives the run-off through several small streams. Oak Orchard Creek, with its tributaries, controls the largest drainage area. Dissection by stream action has not been very thorough, and such valleys as have been formed are in very few places more than a quarter of a mile wide. Most of the flood plains range from only 100 to 300 feet in width. The channels of the larger streams are still in a young stage, and valley walls have not been cut very deep below the level of the surrounding country. Along the upper parts of tributaries, near the heads or sources of streams, the flood plains are not well defined, and they merge without pronounced cuts or drops into the adjoining slopes or uplands. Farther down along the streams, the valley bluffs become more distinct, and the depth to the valley floors ranges from about 10 to 30 feet. Near Lake Ontario, and for short distances elsewhere in the northern part of the county, streams have cut down to form gorges ranging in depth from 40 to 60 or more feet. Geological rock formations are exposed in the more precipitous gorges, and short falls occur in some streams as they flow from one geological formation to the underlying one.

The interstream ridges are wide, and parts of them lack sufficient drainageways to drain thoroughly all parts of the area. A few farms in each town are without natural drainage outlets, and connections have been made to them in some localities by farm or district ditches. In some of the low flat sections, ground waters move

away too slowly to allow full utilization of the land without the installation of expensive drainage systems. The streams have sufficient gradient along the lower parts of their courses to develop a moderately swift current, and in several places water has been utilized for hydroelectric power and for the operation of mills.

Before settlement of this part of the country, the land included in the present Orleans County supported a heavy stand of trees. In early times part of the country north of the so-called ridge road was known as "north woods," owing to the heavy timber growth. On the better drained sites, or dry land, the predominant trees were beech, maple, oaks, basswood, tuliptree, elm, hickory, white pine, and hemlock. The swamps, or low wet lands, supported a growth of willow, birch, alder, black ash, tamarack, soft maple, white cedar, yellow cedar, and sycamore. Some white pine trees grew in scattered localities along Oak Orchard Creek and in the swampy areas of Barre Town. Chestnut grew in places in Ridgeway Town. Second-growth trees include elm, maple, poplar, hickory, ash, and several species of oaks. In wood lots there is a moderately dense undergrowth including seedlings from the parent trees, briars, vines, berrybushes, ferns, coarse grasses, and sedges.

In the early days, a large part of the timber was burned where it fell, and the ashes were made into potash, or black salts, which provided a source of revenue to the pioneer. Much oak was squared and sent to Europe for shipbuilding. Few large tracts of timber remain, and the tree growth is confined principally to farm wood lots.

Orleans County was established as a separate political unit when it was set off from Genesee County, November 11, 1824. It was named for the French royal house of Orleans. The territory originally was part of the domain of the Seneca Indians. Additional land was obtained from Genesee County on April 5, 1825, when the town of Shelby was annexed and the present boundaries established.

The earliest settlers emigrated chiefly from the New England States, eastern New York, and Pennsylvania. They were of English and German descent, and a large proportion of the present rural population is descended from them. In some villages and communities, as Medina, Albion, Fancher, Holley, and Brockville, Italians and Poles have come in during recent years.

The pioneers encountered obstacles and endured great hardships in establishing themselves. The land was wet and inadequately drained in many localities, and, living in such an environment, the people suffered frequently from disease and sickness. They made small clearings and subsisted on the meager crops they succeeded in growing. Wild game, including bear, deer, wolf, raccoon, fox, squirrel, and birds provided a plentiful supply of meat, and the fur was used for clothing or sold to traders. For a long time it was difficult to keep sheep and cattle because of the ravages of wolves. As the forests were cut and settlers came in larger numbers, the wild animals were hunted until the larger ones were exterminated.

Wheat was the important grain crop grown by the early farmers, but, previous to the construction of the Erie Canal, marketing the grain was a big problem. The ridge, which marked a shore line of old glacial Lake Iroquois and which was used by Indians as a trail

for traversing the county from Niagara River eastward to points beyond Rochester, was turned into a highway in 1798. This historic trail, now United States Highway No. 104 and locally known as the ridge road, was used for transporting wheat to marketing points. Barley did not come into use until a much later date than wheat, and rye was not sown for many years.

A tremendous impetus to farming and settlement of the land resulted with the construction of the Erie Canal, and following November, 1825, when the canal was opened from Buffalo to Troy, the economic condition of the county underwent a marked change, as ready markets for the agricultural products were made available in other parts of the State and in foreign countries. When the canal became navigable, Albion, Holley, Knowlesville, Medina, and many other small villages were built on its banks. As the land was cleared and drained, many orchards of peach and apple trees were planted.

The Holland Land Co. at one time owned a large part of Orleans County. This company sold land at prices ranging from \$2 to \$5 an acre, depending on the location and kind of land. The company was liberal in extending credit and in this manner aided development of the territory.

Medina, Albion, and Holley are the principal villages. Their respective populations, according to the latest census (1930), are 6,071, 4,878, and 1,558. Albion, the county seat, is in the central part of the county.

The rural population is evenly distributed and averages about 45 persons a square mile. In 1880, the rural population was 26,496 persons, or 87.9 percent of the total for the county, but since that time the towns and villages have increased in population and the number of people residing in the country districts has gradually decreased. The Federal census for 1930 reports a rural population of 17,846 and an urban population of 10,949.

Transportation facilities are good and are adequate for the normal demands of rural and town business requirements. Two branches of the New York Central Railroad system traverse the county and serve all the principal communities, automobile bus and freight lines supply transportation for quick and efficient service to meet local demands, and water transportation is maintained on the Barge Canal (an enlargement of the old Erie Canal) during the greater part of the year. These facilities connect with such centers of population as Buffalo, Rochester, Albany, and New York City. Public roads are numerous, and most of them are kept in good condition. A number of excellent State and county highways of modern construction connect the important points in this and other counties.

CLIMATE

The climate is characteristic of an interior land area, even though this county is near enough to the ocean and large lakes to be considerably influenced by them. The climate, though temperate, is subject to great extremes of heat and cold. Climatic factors differ in different parts, the section bordering the lake having comparatively milder conditions and a somewhat longer growing season than the more inland sections, as the ameliorating influence of the lake

gradually lessens toward the southern end of the county. The tempering effect of Lake Ontario is well evidenced in its influence on the budding period of fruit trees. The trees in orchards occupying a narrow belt of land, about 1 mile wide, bordering the lake are a few days later in blossoming than trees south of the lake, and those nearer the ridge are apt to blossom first, the difference between the blooming period of trees along the lake shore and of those near the ridge ranging from about 10 to 15 days. This is due to cold north winds sweeping across the lake and holding the temperature a little lower along the lake belt than farther away. The slow temperature changes of a large body of water tend to reduce to some degree the cold of winter and the heat of summer. The retardation of the seasons is of great economic importance, especially in the production of fruit, as delayed growth along the lake in spring lessens the hazards of injury from late frosts, and early fall frosts are less frequent, thus prolonging the growing season.

The average date of the last killing frost at Appleton, Niagara County, is May 4 and of the first is October 15. On the lake plain, the growing season is approximately 164 days, but in the southern part of the county, it is somewhat shorter; consequently, the climate in the southern part is not so well adapted for fruit growing, and general and dairy types of farming have developed. The latest recorded frost at the Appleton station occurred on June 5 and the earliest on September 25.

The prevailing winds are from the west. The alternation of weather conditions is due to the passage of successive areas of high and low pressure from west to east, producing alternations of clear, dry, cloudy, and rainy weather.

The climate is favorable for most of the crops grown. Corn, which responds to warm weather and rich limy soils, will do well in most parts of the county. Potatoes and oats are better suited to the somewhat cooler conditions in the southern part. A concentration of a fruit belt in the northern part has been influenced more by the effects of the lake on climatic conditions than to soil conditions.

The mean annual precipitation, which is fairly evenly distributed throughout the year, is variable in different parts of the county. In the northern section, precipitation may be a little less than the average, but such differences as do occur are of minor significance so far as ordinary crop production is concerned. The growing period is favored by receiving a greater quantity of rain than the fall and winter periods.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at the United States Weather Bureau station at Appleton, Niagara County. These data are fairly representative of climatic conditions in Orleans County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Appleton, Niagara County, N. Y.*

[Elevation, 300 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1920)	Total amount for the wettest year (1889)	Snow, average depth
December.....	°F. 29.4	°F. 67	°F. -6	Inches 2.28	Inches 2.08	Inches 5.99	Inches 10.0
January.....	25.7	70	-13	2.55	1.03	9.50	12.0
February.....	23.4	69	-12	1.94	1.06	4.62	12.4
Winter.....	26.2	70	-13	6.75	4.17	20.11	34.4
March.....	32.5	79	-7	1.98	1.33	2.57	6.7
April.....	43.9	87	9	2.35	2.33	6.04	1.6
May.....	64.6	95	26	2.93	.16	7.26	.3
Spring.....	43.7	96	-7	7.24	3.82	15.87	8.6
June.....	64.2	95	32	2.85	.96	12.13	.0
July.....	69.9	106	40	3.34	3.55	6.98	.0
August.....	67.7	100	41	2.70	.91	1.81	.0
Summer.....	67.3	106	32	8.80	5.42	20.92	.0
September.....	61.8	96	31	2.68	1.62	6.61	(1)
October.....	60.6	87	19	2.97	2.35	8.32	.1
November.....	59.7	72	12	2.86	3.17	15.23	3.1
Fall.....	50.7	96	12	8.51	7.14	30.23	3.2
Year.....	47.0	106	-13	31.39	20.55	87.13	46.2

¹ Trace.

AGRICULTURAL HISTORY AND STATISTICS

Agriculture has been practically the only important industry since the country was opened and the land first settled. The pioneer first cleared a patch of land which was used principally to grow subsistence crops, such as wheat, corn, potatoes, fruits, and vegetables. He also grew flax and raised sheep to supply wool with which to clothe his family. Oxen were used largely as work animals, farm conditions were hard, and farming methods followed were slow, crude, and laborious. But as other settlers arrived and the population increased, there was a surplus of farm products for market, and the demand for such products increased. At first it was necessary to transport the produce long distances by wagon or sled, which was a slow and tedious method. When the Erie Canal was opened for traffic, an incentive was created for agricultural development that soon changed the economic outlook for the county, various phases of farming were stimulated, and products found their way to new and larger markets. At a later period railroads were constructed and new roads built, and now excellent facilities are provided for carrying farm products to the largest markets of the country.

In 1880, about 99 percent of the entire county was divided into farms, and approximately 87 percent of the farm land was improved

for cultivation. At that time, the county had 3,038 farms with an average size of 83 acres. About 24 percent of the farms were operated by tenants, and the rest were operated by the landowners. Rotation of crops was followed, and, as a large part of the crops grown was returned to the land in the form of manure, the necessity for using commercial fertilizers was not generally considered.

Farming operations during this period were devoted largely to the production of cereals and hay. Yields of hay averaged 1.2 tons an acre, corn 41 bushels, oats 35 bushels, wheat 19 bushels, rye 15 bushels, barley 22½ bushels, buckwheat 15 bushels, and potatoes 107 bushels. Hay crops covered the largest acreage. Of the grain crops, wheat ranked first, exceeding the combined area of corn and oats. Barley at this time was an important crop, but during succeeding years its production was curtailed considerably.

During the following decades the number of farms gradually decreased, also the total acreage devoted to farming. Census statistics for 1930 report that the 2,392 farms in the county in that year included 213,498 acres with an average of 89.3 acres a farm, of which 72.7 acres was classed as improved land, which included cropland and plowable pasture. In 1934, the amount of land available for crops was 176,721 acres. The number of farms was 2,608 on January 1, 1935.

Table 2 shows the acreage devoted to the principal crops in Orleans County, as reported by the Federal census, in 1879, 1889, 1899, 1909, 1919, 1929, and 1934.

TABLE 2.—*Acreage of principal crops in Orleans County, N. Y., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1934
	Acres						
Corn.....	12,446	6,558	10,584	8,434	6,377	2,722	4,176
Oats.....	12,409	16,716	17,536	17,245	10,594	10,431	11,548
Wheat.....	28,666	26,011	32,318	20,868	29,793	17,777	17,262
Barley.....	17,286	15,258	5,058	2,150	5,260	2,781	2,380
Buckwheat.....	831	908	579	632	1,120	1,027	-----
Dry edible beans.....			19,194	19,435	748	4,650	7,279
Potatoes.....	2,993	2,710	3,239	4,111	3,021	1,489	3,214
Hay (all kinds).....	33,608	41,475	41,560	42,605	46,051	35,388	39,108
Tame grasses.....							
Timothy alone.....				14,286	17,287	-----	-----
Timothy and clover.....				24,525	24,637	26,251	28,210
Clover alone.....				2,519	2,814	2,013	5,350
Alfalfa.....				26	320	1,307	3,052
Other tame grasses.....				39,015	651	807	735
Wild grasses.....				68	347	83	134
Grains cut green.....				550	145	119	68
Annual legumes saved for hay.....						10	12
Silage crops.....						3,961	2,615
Coarse forage.....				355	1,212	2,979	1,787

¹ Includes wild grasses.

During these years, adjustments took place to meet changing conditions coincident with the development of the country at large. Specialized forms of farming were engaged in and now have become dominant features of the agriculture. The outstanding change took place with the expansion of fruit growing, which now furnishes work for a large number of people and is the largest single source of income. A large acreage of land annually is devoted to producing vegetables for canning. In 1929, more than 11,000 acres were utilized for

the growing of vegetables for sale, and in 1934, 15,183 acres were used for this purpose.

Throughout these years of change, farmers still continued the production of general farm crops, and corn, oats, and wheat continue to be the main cereal crops. Some fluctuation in acreage takes place from year to year, influenced in large measure by prevailing economic conditions.

Buckwheat has never been an important crop. Frequently it is grown in fields where conditions prevent the planting of some other crop, and some farmers use it as a cover crop in orchards or on land not suitable for other grains. Potatoes are grown mainly for home consumption. They are not considered a commercial crop nor are they grown on a large scale, except by a few farmers or those specializing in truck crops.

The acreage in hay and legumes has always exceeded that of any other crop. Timothy is the major grass crop, and it is commonly sown in combination with red or alsike clover. During recent years the acreage devoted to alfalfa has increased. This crop grows well on the sweet, or limy, soils.

In general, crops are grown to support dairying which is carried on in conjunction with general farming. A large acreage is in grass for hay and permanent pasture for the use of livestock. Oats are grown successfully and can be used as a nurse crop for grasses. Many farms have silos, and a large part of the corn crop is used for silage.

Although dairying is followed to some extent by the farmers throughout the county, it is practiced more extensively in the southern part, where it has been an important agricultural pursuit for a long time. Most of the dairy cows are Holstein-Friesians, Guernseys, and Jerseys, or grades of these breeds.

Concentrated in a belt of land bordering Lake Ontario and extending through Niagara, Orleans, Monroe, and Wayne Counties is one of the largest areas in the United States for growing barreled fruits. That part of the fruit belt in Orleans County extends across the northern half and is made up of small and large commercial orchards. Some of the fruit farms range from 200 to 400 or more acres in size, but the greater number of orchards range from a few acres to 50 acres. Apples constitute the main orchard crop, and other important tree fruits are peaches, pears, cherries, plums, and quinces, ranking in the order named. Cherry, plum, and quince trees usually are set out in small orchards. The leading varieties of apples are Baldwin, Rhode Island Greening, Ben Davis, Wealthy, McIntosh, Northern Spy, and Tompkins King. The leading commercial peach is the Elberta, but the Rochester, Hale, Bell, Early Crawford, and other varieties are grown. In the southern part of the county, fruit orchards are scattered, and most of them are small.

Some grapes are grown, mainly for local consumption or home use. Small fruits, such as strawberries, black raspberries, red raspberries, and blackberries, are grown in small patches, mainly for home consumption, the surplus being sold at local markets or from highway stands. Cantaloups were grown on 22 acres in 1929.

Table 3 shows the number of orchard trees and grapevines, also the number of acres devoted to small fruits in 1889, 1899, 1909, 1919, 1930, and 1935.

TABLE 3.—*Orchard fruits and small fruits grown in Orleans County, N. Y., in stated years*

Fruit	1889	1899	1909	1919	1930 ¹	1935 ¹
Apples.....	<i>Trees</i> 591,767	<i>Trees</i> 629,401	<i>Trees</i> 549,749	<i>Trees</i> 657,004	<i>Trees</i> 717,150	<i>Trees</i> 638,894
Peaches.....	86,445	110,090	157,934	409,467	233,683	222,097
Pears.....			196,513	342,974	228,213	243,260
Plums and prunes.....			28,313	21,580	17,740	19,785
Cherries.....			14,682	43,987	40,496	76,318
Quinces.....					12,787	
Grapes.....	<i>Vines</i> 157,623	<i>Vines</i> 38,321	<i>Vines</i> 43,037	<i>Vines</i> 85,452	<i>Vines</i> 81,395	
Strawberries.....	<i>Acres</i> 42	<i>Acres</i> 53	<i>Acres</i> 41	<i>Acres</i> 41	<i>Acres</i> 23	
Raspberries.....	195	83	59	73		
Blackberries and dewberries.....	19		12	8		

¹ Acreages of small fruits are those of previous year.

A large acreage is under cultivation to vegetable crops. The growing of truck crops for the open market is concentrated on organic soils or muck land scattered across the southern part of the county, but the growing of vegetables for canning is well distributed. Good roads and the use of automobile trucks have aided the development of vegetable growing in all sections. The chief vegetable crops are cabbage, carrots, celery, sweet corn, cucumbers, lettuce, onions, peas, and tomatoes, and in addition a small acreage is planted to beans, asparagus, cauliflower, and beets. Tomatoes, peas, and sweet corn generally are grown under contract for canning companies located within the county, but such vegetables as lettuce, onions, and celery are packed and shipped to outside markets. Small white beans are grown with good results.

Poultry provides a steady source of income on a large number of farms, the revenue being derived mainly from the sale of eggs. Sheep raising is conducted in all parts, the 1930 census reporting 56,012 head of sheep, but fewer were reported in 1935. A few hogs are kept on each farm, to supply the home demand for meat.

Table 4 gives the value of all agricultural products by classes in 1909, 1919, and 1929.

TABLE 4.—*Value of agricultural products and domestic animals, in Orleans County, N. Y., in stated years*

Crops	1909	1919	1929	Livestock and products	1909	1919	1929
Cereals.....	\$1,122,667	\$2,222,873	\$648,522	Domestic animals.....	\$2,581,226	\$3,896,174	\$2,177,651
Other grains and seeds.....	638,676	54,704	258,442	Dairy products sold and butter churned.....	238,025	651,650	604,058
Hay and forage.....	705,245	2,051,912	768,743	Poultry and eggs.....	254,025	477,051	840,737
Vegetables, including potatoes and sweet-potatoes.....	509,996	1,307,579	1,187,335	Wool shorn.....	71,873	129,507	89,628
Fruits and nuts.....	1,961,639	4,071,853	2,436,771	Total.....	3,145,751	5,154,382	3,712,074
All other field crops.....	104,151	2,681	253	Total agricultural products.....	8,186,125	14,865,984	9,010,140
Total.....	5,040,374	9,711,602	5,298,066				

The annual expenditure for commercial fertilizer is large. In 1919 it amounted to \$342,187, and in 1929 it was \$285,005. Much of this sum is expended for mixed products, but separate ingredients also are purchased, to be mixed on the farm or to be used alone, to meet the requirements of a particular crop. Mixed fertilizer is sown with grain in quantities deemed essential for the systems of rotation followed. Superphosphate is used alone to some extent for corn, potatoes, and oats. Nitrate compounds are applied to individual trees and to vegetable crops. Sometimes top dressings are applied for grain crops. A very popular fertilizer mixture is 2-12-2¹, and about 50 percent of the fertilizer purchased is of this combination. Other mixtures in wide use are 5-10-5 and 2-8-10. Besides these, the following mixtures are used more or less: 4-16-20, 7-6-5, 2-8-5, 4-16-4, 4-12-4, 2-14-4, and 3-10-6. The use of the commercial mixtures is rather indiscriminate on all kinds of soils and for all crops. They are applied broadcast, in hill or row, and as a side dressing. A widespread use of 2-8-10 and 5-10-5 is made for most vegetable crops, and 2-8-10 is favored for cabbage. Acre applications range from 150 to 300 pounds for cereal crops and from 500 to 1,000 or more pounds for truck crops.

Farm labor in former years was not very plentiful because of the attractive wages offered in nearby industrial centers, and the young people were leaving the farms to find occupations in towns and cities, but now farm labor is plentiful. Most of the farmers depend on members of their family for various farm duties, or they exchange labor with neighbors. The amount expended for labor during 1929 was \$820,433. In harvesttime, under normal conditions, day laborers receive about \$3 and board. Monthly wages range from \$30 to \$60 with board included. Hired men with families have the use of tenant houses and receive from \$150 to \$300 a year and privileges which include wood, meat, garden vegetables, and other subsistence requirements. During small-fruit harvest, boys and girls are hired to pick such fruits as cherries or berries and are paid by the quart. Apple and peach pickers are obtained locally or come in from other sections for the period of harvest. They are paid on a unit basis of a barrel or bushel. The pay differs from one season to another, depending on the market price of the fruit.

The 1935 census figures indicate that 68.9 percent of the farms are operated by owners and part owners, 30 percent by tenants, and 1.1 percent by managers. Practically all the tenant farms are rented for a share of the crop, usually on a 50-50 basis. The owner may supply some of the seed and fertilizer, and the tenant furnishes labor, livestock, and tools.

The farms in most localities are well equipped, a number of farms being completely mechanized and many farms being equipped with labor- and time-saving machines. Farm dwellings as a rule are large, are well built, have attractive surroundings, and are maintained against depreciation. Barns are amply large for the accommodation of livestock and farm products. Orleans County is in one of the progressive agricultural areas of the State. The farmers endeavor to maintain fertility of the soil and keep their equipment and buildings in good condition.

¹ Percentages, respectively, of nitrogen, phosphoric acid, and potash.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field. The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil² and its content of lime and salts are determined by simple tests.³ Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics, soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase. Areas of land, such as coastal beach or bare rocky mountainsides that have no true soil, are called (4) miscellaneous land types.

The most important group is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first recognized. Thus, Ontario, Honeoye, Dunkirk, and Clarkson are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Ontario fine sandy loam and Ontario loam are soil types within the Ontario series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, which differs from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example,

² The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

³ The total content of readily soluble salts is determined by the use of the electrolytic bridge. Phenolphthalein solution is used to detect a strong alkaline reaction.

within the normal range of relief for a soil type, there may be areas that are adapted to the use of machinery and the growth of cultivated crops and others that are not. Even though there may be no important difference in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such an instance, the more sloping parts of the soil type may be segregated on the map as a sloping or hilly phase. Similarly, soils having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

SOILS AND CROPS *

In a discussion of soils, such as feature Orleans County, it is well to know about and appreciate certain geological factors and events that have a bearing on their physical and chemical composition.

Many thousand years ago this territory, in common with a large part of northern United States, was covered by several successive huge continental ice sheets that crept slowly down from the north. These sheets of ice, or glaciers, through their forces of grinding, abrasion, scraping, accumulation, and melting, changed and smoothed the land from its original form to its present appearance. They deposited accumulations of sands, silts, clays, gravel, and rock fragments in front of or underneath the glaciers, and water from the melting ice carried and deposited sediments over a large territory. Lake Iroquois, a high lake that had one of its shore lines along the ridge, occupied the Ontario plain between the ridge and the present Lake Ontario shore line. It was responsible for much of the unconsolidated bedded material laid down in that section. The ice, in passing over the country, ground, picked up, and carried fragments of local rocks for short distances and mixed them with rocks and soil debris from other areas to the north, resulting in the deposition of a heterogeneous mass of materials.

All the present land forms, as valleys, hills, plains, and terraces, have the imprint of glacial action. The glacial deposits are distributed unevenly over the underlying rock formations. In some localities they are shallow and rock lies within a few inches of the surface, whereas in other places the debris is many feet thick. In some places the accumulations left by the ice were reworked by moving waters or lakes and the material was built up into stratified layers diversified in texture, thickness, and arrangement.

The soils have been produced through soil-forming agencies acting on the complicated mixture of glacial debris, and the products resulting from weathering activities have given rise to a large number

* The soils of Orleans County join very well with the soils of Monroe County, with the exception of slight differences in texture. No attempt has been made to join the soils of Orleans County with those of Genesee County, because the scale used in mapping is different and the soils of Orleans County are mapped in greater detail.

of different kinds of soils which are intimately associated, and a change from one to another may occur within a horizontal distance of only a few feet. This condition features the soils in the northern half of the county, but in the southern part, the soil belts are fairly uniform and broad and do not have the intricate design characterizing the soils in the lake plain.

The contribution of local materials from geological formations beneath the soil mantle was considerable and in excess of that from foreign sources, and the chemical and physical characteristics of these local materials were passed on to the soil in modified form induced by weathering processes. These features exert some influence on the inherent fertility of the land and its productive capacity. Fragments from the red sandstone and shales in the northern part of the county, on decaying, have exercised a strong influence on the color of the soils in that section, as the color of the rocks is imparted to the soils to some extent. Likewise the breaking down of limestone fragments in the glacial accumulations, picked up by ice action, in the southern part have supplied more materials for the soils than have other rocks. These limestone soils are naturally more suitable for a leguminous crop, such as alfalfa, than are other soils. Rock fragments from localities outside the county, brought in during the glacial epoch, are granites, crystallines, sandstones, and shales. Their influence, in general, is less than the influence of the local rocks.

One of the outstanding factors that influences development of soil material, as well as land utilization, is drainage. Some materials are saturated or waterlogged for a considerable period each year, and the movement of ground water from the land is retarded. Because of an excess of water, activities of soil-forming agencies are hindered and restricted in producing uniform conditions or developments. The relief of the land, as well as the character of the soil material, affect disposition of the soil water.

In wet places, the accumulation of leaves, twigs, and roots, or other organic matter, and their incorporation with the mineral matter have been favored. Most of the poorly drained soils are dark as a result of this intermixing. In well-drained positions, organic matter from the vegetation soon decays and leaches away with other elements by soil-developing processes, and, in contrast, light-colored soils are formed.

On the basis of color, Orleans County includes two large soil groups. The utilization of the land and results obtained on it are reflected by drainage, and on this basis, the soils may be divided into three large groups for convenience in discussion and in describing their relative value and use. Under a classification of this kind, the soils may be divided into well-drained soils, poorly drained soils, and a large number of soils affected by an intermediate drainage condition. Such soils are not poorly drained to the same degree as the wet soils nor are they sufficiently well drained to class them in the first group.

In the following pages the soils are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 5.

TABLE 5.—*Acreage and proportionate extent of the soils mapped in Orleans County, N. Y.*

Soil type	Acres	Per cent	Soil type	Acres	Per cent
Ontario loam.....	22,528	8.8	Berrien loamy fine sand, shallow phase.....	192	.1
Ontario fine sandy loam.....	1,088	.4	Berrien very fine sandy loam.....	896	.4
Cazenovia loam.....	4,098	1.6	Rimer fine sandy loam.....	2,008	1.2
Honeoye silt loam.....	3,200	1.3	Granby loamy fine sand.....	4,352	1.7
Dunkirk silt loam.....	14,336	5.6	Colwood fine sandy loam.....	1,600	.6
Dunkirk silt loam, light-textured subsoil phase.....	1,280	.5	Colwood silt loam.....	1,856	.7
Dunkirk loam.....	960	.4	Toledo silty clay loam.....	2,240	.9
Dunkirk gravelly loam.....	9,344	3.7	Toledo silt loam.....	4,096	1.6
Dunkirk fine sandy loam.....	192	.1	Poygan silt loam.....	6,208	2.4
Clarkson loam.....	17,664	6.9	Poygan silty clay loam.....	2,560	1.0
Clarkson fine sandy loam.....	1,024	.4	Collamer silt loam, poorly drained phase.....	2,048	.8
Medina silt loam.....	1,088	.4	Wauseon fine sandy loam.....	3,456	1.4
Dunkirk gravelly loam, shallow phase.....	394	.2	Brockport silt loam, imperfectly drained phase.....	576	.2
Clarkson loam, shallow phase.....	704	.3	Lyons silt loam, shallow phase.....	610	.3
Farmington silt loam.....	2,432	1.0	Lockport silty clay loam, poorly drained phase.....	1,702	.7
Farmington loam.....	960	.4	Lyons loam.....	5,440	2.2
Alton coarse sandy loam.....	2,088	1.1	Lyons silt loam.....	1,098	.4
Alton gravelly loam.....	1,728	.7	Hilton loam, poorly drained phase.....	1,024	.4
Otisville gravelly loam.....	448	.2	Bono loam.....	704	.3
Groton gravelly loam.....	2,176	.9	Muck.....	5,760	2.3
Arkport fine sandy loam.....	3,648	1.4	Muck, shallow phase.....	6,784	2.6
Arkport fine sandy loam, smooth phase.....	5,184	2.1	Edwards muck.....	128	.1
Petoskey fine sandy loam.....	4,416	1.8	Peat.....	64	(1)
Hilton loam.....	16,512	6.5	Genesee silt loam.....	2,752	1.1
Hilton silt loam.....	3,840	1.5	Hamlin silt loam.....	1,472	.6
Hilton silt loam, shallow phase.....	1,472	.6	Hamlin silt loam, high-bottom phase.....	256	.1
Hilton fine sandy loam.....	768	.3	Wolcottsburg silt loam.....	2,496	1.0
Collamer silt loam.....	2,112	.8	Eel silt loam.....	4,096	1.6
Lucas silt loam.....	2,348	.9	Eel silt loam, shallow phase.....	256	1
Collamer silt loam, heavy phase.....	8,768	3.4	Wayland silty clay loam.....	896	.4
Schoharie silt loam.....	3,648	1.4	Marsh.....	128	.1
Schoharie silty clay loam.....	3,968	1.6	Made land.....	640	.3
Fulton silty clay loam.....	12,672	5.0	Quarries.....	381	.2
Hilton silt loam, heavy-subsoil phase.....	2,624	1.0	Total.....	253,440	—
Brockport silt loam.....	2,112	.8			
Lockport silty clay loam.....	3,600	1.3			
Berrien loamy fine sand.....	11,520	4.5			

¹ Less than 0.1 percent.

WELL-DRAINED SOILS

The well-drained soils occupy a large total area and occur in all parts of the county. Their surface layers readily absorb rainfall, and internal drainage of the subsoil layers ranges from good to excellent. These soils are light colored, low in organic matter, and consequently contain little nitrogen. The materials range from light-textured sands to silty clay loams with heavy subsoils. The relief is undulating, gently rolling, or smooth, and, for the most part, the land is suitable for easy cultivation.

The main agricultural crops are grown on these soils, and they produce the greater part of the farm products. General farm crops, such as cereals, hay, legumes, vegetables, and fruits, are produced on them without any great discrimination in the kind of soil.

The surface soils are slightly acid, but the lower part of the subsoil and the substratum contain sufficient lime carbonate to make the soil material sweet. Other mineral elements have been leached from the upper layers to the lower parts of the soil, which makes it necessary that these soils receive good treatment in order to maintain or improve their fertility.

The surface soils are of good physical structure. The subsoils, however, differ in their chemical and physical characteristics. Some

are friable and mellow and possess properties favoring cultivation under a wide range of moisture conditions. Others have tough, tight, or compact clay layers and are more difficult to handle. These differences are reflected in the agricultural value of the soils and the results obtained on them. The soils in this group are discussed in five subgroups as follows: Soils with friable subsoils, soils with friable fairly heavy subsoils, soils with compact subsoils, soils with shallow subsoils over rock, and soils with friable subsoils and loose sandy or gravelly substrata.

SOILS WITH FRIABLE SUBSOILS

Ontario loam.—One of the most widely distributed, uniform, and important agricultural soils is Ontario loam. A vertical exposure through the soil displays several distinct layers, the most typical of which are as follows: (1) A surface soil consisting of fine-textured friable mellow medium dark brown or grayish-brown loam ranging from 7 to 9 inches in thickness; (2) a subsurface material, just a little below plow depth, that is light-brown, medium-brown, or yellowish-brown slightly heavier loam possessing a thin platy but friable structure or arrangement of the soil particles; (3) an 8- to 15-inch subsoil layer, lying at a depth ranging from about 14 to 18 inches, that is of distinctly deeper color and heavier texture, being deep-brown, buff, or deep yellowish-brown silty clay loam or light clay loam, having very little compaction and crumbling to a friable mass; and (4) the substratum, which is lighter in color and texture than the layer above, most typically consisting of a light-brown friable mixture of silt, loam, and fine sandy loam.

A characteristic of this soil is the presence of small or medium-sized fragments of sandstone and limestone in all layers, but not in sufficient quantities to interfere with cultivation. A smaller number of granite and crystalline boulders and gravel are present. Limestone fragments are more abundant than other kinds of stone, the limestone consisting of broken pieces derived from beds of limerock lying beneath the soil at a depth of 10 feet or deeper. The presence of stones tends to improve the physical condition of the soil, and the decomposition of so many different kinds adds fertility to the land. Lime is present in the soil in quantities sufficient to meet the requirements of most plants, and lack of lime is not so important a factor in considering soil fertility as are other conditions.

Areas of Ontario loam occupy the higher elevations on the smoothly undulating or gently rolling land. Run-off of rainfall is good, but a large part of the water is absorbed by the soil and held for the needs of growing crops. This is not a dry soil, as the physical character of the material prevents rapid loss of moisture. Seeped spots occur in places on slopes, and small wet areas occupy slight depressions in some fields, but most of these are only a few feet in width and therefore are too small to be indicated on the soil map. Streams and drains are not numerous, and a number of farms are not reached by natural drainageways.

Ontario loam is recognized as one of the better general farming soils, and more than 95 percent of it has been cleared and utilized for some type of agriculture. Small wood lots occupy the rest of

the land, generally on slopes or around areas unfavorable for cultivation. The trees are mainly second-growth elm, maple, some beech, ash, wild cherry, hemlock, and hickory.

The land presents little difficulty for cultivation and can be worked to a suitable condition for all crops grown. The soil is inherently moderately productive, and, under good management, it is highly productive. General farming, in association with dairying, constitutes the major agricultural activity, and in addition, some attention is given to the growing of vegetables and tree fruits. The main crops include oats, wheat, corn, beans, hay, cabbage, tomatoes, and potatoes. The largest acreage on each farm is generally in hay and pasture land. The hay grasses include timothy, red clover, and some alfalfa which, in recent years, has gradually increased in acreage. Orchards, ranging from 5 to about 10 acres in size, are established on many farms.

The farms are divided into small fields, in general ranging from about 5 to 8 acres and on a few farms from 10 to 15 acres. Pastures receive little attention or management. They are covered by a natural growth of grasses or vegetation but ultimately are placed in a rotation of crops. Bluegrass, wild clovers, timothy, redtop, and weeds are the common cover of pasture lands.

Farms on Ontario loam are well equipped for the type of farming followed. Sheep are raised on some. Only a few hogs are kept on each farm, usually a sufficient number to supply meat for the needs of the family. Tomatoes and peas are grown for canning companies under contract by some farmers, and beans, cabbage, and garden truck also are grown.

The use of commercial fertilizer is widespread, ready mixed as well as separate ingredients being used. The most popular mixtures are 2-8-10, 4-8-4, 5-10-5, and 4-12-4. Superphosphate and nitrate of soda are used alone on some crops. The rates of application and kinds used depend on the crop rotations followed. All barnyard manure produced is spread on the fields, but on many farms the supply is inadequate.

Alfalfa yields range from 1½ to 3 tons an acre from two or three cuttings, and clover and timothy hay averages about 1½ tons. Most of the hay is fed on the farms, and a very little is baled and shipped. Oats and wheat are the leading grain crops. Wheat produces from 15 to 40 bushels and oats from 40 to 75 bushels an acre. White beans, and sometimes red varieties, are grown on from 2 to 5 acres on many farms, and yields range from 8 to 15 or more bushels an acre. Yields of cabbage range from 8 to 20 tons and of tomatoes from 10 to 15 tons. Corn is grown for the feeding of livestock or the making of silage. That for silage yields from 8 to 10 tons an acre.

Wheat and oats are fed to the farm livestock. Some farmers do not grow all the feed needed for their cattle and have to purchase some from cooperative organizations. Potatoes do well, but the acreage is small on this soil. A large part of the farm income is derived from the sale of dairy products, vegetables, eggs, beef, and fruit. Although orchard trees do well, they are more susceptible to frost damage than on soils nearer the lake.

Ontario loam occurs only in moderate-sized bodies in the southern part of the county. This soil is associated with and has small inclusions of other soils, as Hilton loam and Schoharie silt loam, but some

areas are uniform and are large enough to cover several adjoining farms.

The included areas of silt loam differ from the typical soil principally in texture, as the surface soil contains a larger quantity of silt particles, but the colors of the underlying layers correspond to those of the loam. The subsoil is somewhat heavier in texture, in places more compact and tight, and this condition tends to render the soil retentive of moisture for some time. As a consequence, the soil in the silt loam areas is colder and does not warm so early or so quickly as the loam.

In some depressions or at the bottoms of slopes, erosion has been responsible for depositing rich soil from adjoining land on top of the soil, and, as a result, the surface layer is deeper than normal and the land is more productive. The subsoil in such places is somewhat more yellow and contains a few gray stains. When wet, the surface material runs together, and on drying it hardens to form a thin crust. The eroded slopes above these areas are less productive than the normal soil. Much of the eroded slopes is in pasture, and many severely eroded spots support only sweetclover. The relief of the included soil is not so uneven as over most of the Ontario loam areas. In the smoother places drainage is slower than elsewhere, and the subsoil is stained lightly with gray and yellow.

Similar crops are grown on the silt loam areas as on the loam soil, and no marked differences in yields result. A greater acreage is devoted to hay and grass fields used as pasture than of the loam areas, and orchards are less common, although the land is just as suitable for fruit.

Bodies of Ontario loam developed along the northern limit of the occurrence of this soil, which adjoin or merge with areas of Clarkson loam, are somewhat lighter colored and slightly more acid to a greater depth than typical. Such areas occupy transitional zones and are more influenced by weathered red shales and sandstones than is common.

Ontario fine sandy loam.—Ontario soils with light-textured sandy surface layers are mapped as Ontario fine sandy loam. The texture of the surface soil ranges from very fine sandy loam to medium sandy loam. Where typically developed this soil has a grayish-brown or brown fine sandy loam surface soil about 8 or 9 inches thick, which is underlain by a light-brown subsurface layer of similar texture. At a depth ranging from 15 to 18 inches is light-brown or brownish-yellow light clay loam that has a faint red cast when moist. The structure, friability, and slight compaction are similar to these features in the corresponding layer in Ontario loam. The substratum, or basal stratum, is light-colored light-textured material such as occurs under all the Ontario soils.

This soil is of small extent. It is developed in small scattered bodies, in association with Ontario loam, in the south-central and southwestern parts of the county. The relief is undulating, smoothly sloping, or gently rolling. The texture and structure of the soil allow the absorption of rainfall and ready passage of excess water.

Practically all the land is used for the production of crops, and the same crops are grown as on other members of the Ontario series. It is considered very desirable for fruit, and the appearance and

yields from apple orchards located on it testify to its suitability for this purpose. Returns from general farm crops average about the same as on Ontario loam.

Cazenovia loam.—The surface soil of Cazenovia loam is medium dark brown or brown loam about 6 or 8 inches thick. On drying cultivated fields have a grayish-brown appearance. The color of the surface soil is influenced by the content of organic matter. Below the surface soil is a layer having similar texture but lighter brown color, which rests on the subsoil at a depth ranging from 12 to 15 inches. The subsoil is conspicuous for its deep color and heavier texture, being a deep-brown or light reddish-brown heavy silt loam or silty clay loam. When the soil material in this layer is moist, the red tint is more pronounced than when it is dry. This layer is from 8 to 12 inches thick. In places it develops a slight compaction, but this is not a uniform condition. At a depth ranging from about 20 to 24 inches, the material grades into the substratum composed of unassorted light-brown or grayish-brown material which averages loam in texture. In some places the surface layer is fine sandy loam or silt loam intricately mixed with the loam, and the underlying layers in places show slight differences in color and texture.

Characteristic of this soil is the presence of fragments and boulders of limestone on the surface and through the soil material. On some narrow long ridges or small knolls, higher than the surrounding soil, the boulders are of such size and number as to be a hindrance to cultivation, some of them measuring from 3 to 5 feet in diameter, but many are much smaller and include gravel and cobbles. Most of the larger stones have been removed from the fields and dumped into piles or along fence rows. The soil mantle is fairly deep in most places, but in some spots beds of limestone are reached at a depth ranging from 6 to 10 feet.

The surface soil is easily cultivated to a mellow seedbed. The included silt loam soil has a moderately heavy subsoil, but this characteristic does not detract from its productivity, which is about the same as that of the loam. This soil has good water-holding capacity as well as adequate internal drainage. The relief is broadly undulating, though locally it is knolly or ridgy, but most of the land lies favorably for cultivation.

The largest development of Cazenovia loam is in the western part of Clarendon Town, and small isolated areas are mapped elsewhere in the southern part of the county. This soil is intimately associated with areas of Lyons loam, Schoharie silt loam, and Ontario loam.

As regards fertility, productivity, and physical and chemical structure, Cazenovia loam is one of the most desirable general agricultural soils in the county. It is not extensive. Approximately 95 percent of the land is cultivated, and the rest is in stony pastures or wood lots. The general farm crops grown are corn, oats, wheat, some barley, alfalfa, clover, and timothy. Special crops, such as peas, tomatoes, cabbage, and beans, are important as cash crops. Legumes are successfully grown, particularly alfalfa. Corn yields from 50 to 75 bushels an acre, wheat 20 to 45 bushels, oats 60 to 75 bushels, cabbage 10 to 15 tons, and hay 1½ to 3 tons. A combination of dairying and general farming is practiced, and the vegetable crops

are grown for canning companies. Some orchards are located on this soil, but fruit growing is not extensive.

Commercial fertilizers used for the various farm crops consist principally of 2-8-10, 5-10-5, and 2-12-4 mixtures, and the same mixtures in heavy applications are used for cabbage and tomatoes. Superphosphate is applied for small grains and nitrate of soda around fruit trees.

Cazenovia loam is slightly higher in value and productivity than Ontario loam.

Honeoye silt loam.—The 8- to 12-inch surface soil of Honeoye silt loam is medium dark brown or grayish-brown gritty loam. It grades abruptly into light-brown or brownish-yellow loam. At a depth ranging from 16 to 20 inches is deep-brown or buff-colored friable material having some compaction and ranging in texture from heavy silt loam to light clay loam. Below this subsoil layer, at a depth ranging from 24 to 26 inches, is slightly compact grayish-brown or light brownish-yellow fine sandy loam or loamy material.

A vertical section of this soil shows three generalized layers as follows: The surface layer of mellow friable material resting on a heavier textured, deeper colored, more or less compact layer which, in turn, rests on a miscellaneous arrangement of light-textured materials. The soil mass contains some rounded, flat, and angular fragments of limestone, shale, sandstone, granite, and crystalline rocks, the greater proportion of which is limestone. The surface soil is slightly acid, but the material becomes less so with depth, and the substratum effervesces freely when tested with acid.

Drainage waters pass readily through the surface soil, and underdrainage is not hindered much by the structure of the subsoil. The lay of the land is favorable for farming, as it has smooth to undulating relief.

Some characteristics of this soil resemble those of Ontario loam, for instance, the color and texture of the surface soil are similar. The Honeoye soil, however, is more friable, less coherent, averages less heavy in the subsoil, and the soil material is not quite so deep. Beds of limestone are reached at a depth ranging from about 6 to 10 feet.

This soil occurs principally in Shelby and Barre Towns, but its total extent is comparatively small. About 90 percent of the land is under cultivation. Cropping systems and the crops grown are typical of those in the southern part of the county. Yields are somewhat lower than on Ontario loam, and the agricultural value is slightly less. Orchards on this soil are not so vigorous in growth or size as those on Ontario loam, as tree growth is retarded by the slighter depth of the soil.

Associated with Honeoye silt loam are several small areas of a soil that is somewhat lighter in texture throughout the soil mass and has little compaction. The soil material is of uniform texture to the substratum. The surface soil, to a depth of about 7 inches, is medium dark brown loam which gives way to light-brown or yellow-brown loam, and this, at a depth of about 18 inches, becomes buff or deep-brown granular heavy loam. At a depth of about 30 inches is light-brown or grayish-brown unassorted fine sandy loam or heavy loam. Limerock occurs at a depth ranging from about 4 to 6 feet

in most places. This soil is mellow, porous, and well drained, the drainage being more rapid than in Honeoye silt loam. Yields are lower than on typical Honeoye silt loam, but the two soils are farmed together for the same kind of crops, and treatment and management are alike.

SOILS WITH FRIABLE FAIRLY HEAVY SUBSOILS

Dunkirk silt loam.—A typical profile of Dunkirk silt loam shows the following layers: (1) A 7- or 8-inch surface layer of brown, grayish-brown, or brownish-gray mellow silt loam; (2) a subsurface layer extending to a depth of 14 or 16 inches and consisting of light-brown or yellowish-brown friable silt loam slightly heavier than the surface layer; (3) a 2- to 4-inch layer of grayish-yellow or gray heavy silt loam irregularly mottled with gray and rust brown, which shows little uniformity and in places is lacking; (4) buff or light reddish-brown stiff heavy smooth cloddy clay, which is heavier textured than the materials in the layers above or below and is the zone of maximum color, resting on the substratum at a depth ranging from about 24 to 28 inches; and (5) light-brown or light reddish-brown moderately compact bedded silt loam alternating with strata of fine sandy loam or very fine sandy loam, with thin seams of lime carbonate. Concretions are formed in the lower part.

This soil in most places is free of stones and gravel, but some occur in spots in the upper part. In the broader tracts the surface soil, on drying, has a gray cast, and, in some localities near the lake, the subsoil has a deeper red tint than typical. Some differences in the tightness and compaction of the subsoil also occur.

This soil is the result of soil-forming agencies acting on stratified materials laid down by water during the glacial age. The soil occurs chiefly in a broken belt extending across the northern part of the county, in association with the Fulton and Toledo soils. The relief is flat, undulating, or gently rolling. In some localities the soil occupies narrow ridges or small irregular bodies, separated from each other by depressions occupied by other kinds of soils. A part of the surface soil on the slopes of some ridges has been removed by erosion. Drainage in general is good, although percolation of ground water in places is slow because of the relief and the tightness of the subsoil.

Dunkirk silt loam is the most extensive soil of the Dunkirk series and is agriculturally important. Under proper moisture conditions it offers little difficulty in the obtaining of a mellow seedbed, and it has comparatively high productive capacity. It is utilized, with the exception of a few farm wood lots, for a wide range of crops. Fruit growing is the outstanding industry in some sections of the belt of Dunkirk soils. Concentration of the orchards is more pronounced in a belt a short distance south of Lake Ontario than in the area bordering the lake. The blossoming period for trees is a little earlier some distance from the lake shore than close to it. On some farms fruit growing is the principal source of income, and on other farms a combination of fruit growing and general farming is followed. Some farmers include dairying in their farm operations as a source of revenue.

Commercial orchards consist mainly of apple trees, and some peaches, pears, plums, and cherries are grown. The small bush

fruits are confined to patches or garden lots. Some of the largest orchards in the county are planted on this soil, and good quality and high yields of fruit are obtained. The long growing season, the modifying effects of Lake Ontario on the temperature, and the character of the soil are factors which render this land suitable for the production of fruit. The orchards, as a rule, are well managed. Very few of them are in sod, but most of them are plowed in the fall and are seeded to a cover crop, either in the fall, spring, or early summer. Thorough spraying of the trees is commonly practiced.

Oats, wheat, barley, and corn are the principal grain crops, oats occupying the largest acreage. Some corn is grown for silage. The acreage devoted to alfalfa is small, but timothy and clover, either alone or mixed, are seeded on a large acreage. Some farmers feed beef cattle during the winter. Some vegetable crops, including tomatoes, sweet corn, peas, cabbage, and beans are grown.

The crop rotation usually includes hay for 2 or 3 years, followed by corn or some vegetable for 1 or 2 years, this by small grains for 1 or 2 years, and then a seeding of grass for hay. Hay yields from 1 to 2 tons an acre, oats 40 to 75 bushels, wheat 10 to 30 bushels, cabbage 6 to 10 tons, and tomatoes 10 to 20 tons. The acreage in potatoes is small, but yields range from 100 to 200 or more bushels an acre.

Most of the farming operations involve the use of commercial fertilizers, both ready-mixed and separate materials being used. Some of the mixtures are 4-12-4, 2-8-10, 5-10-5, and 2-12-6, and higher analyses, or more concentrated materials, as 4-24-4, are sometimes substituted. Nitrate of soda is applied to orchards, and some is used as a side dressing for grain or vegetables. Superphosphate is used for cereals, corn, and potatoes. Lime is spread periodically by some farmers.

A large proportion of this land is extensively used and well farmed, and it supports a profitable agriculture under normal economic conditions.

Gravelly areas closely associated with Dunkirk silt loam and included in mapping contain both rounded and platy small stone fragments, most of which are sandstones and shales. Gravelly areas have a flat or undulating relief, and the structure is less compact than typical. Drainage is good, and percolation is aided by the gravelly character of the soil material. These gravelly areas are used most extensively for the production of orchard fruits. The trees maintain a uniformly healthy growth and produce good yields. The growing of general field crops is successfully combined with fruit growing. The system of management and the use of commercial fertilizers are similar to those for Dunkirk silt loam, and yields are equal to those obtained on that soil.

Dunkirk silt loam, light-textured subsoil phase.—The light-textured subsoil phase of Dunkirk silt loam consists of material resembling typical Dunkirk silt loam but does not have all its characteristics. A representative profile of this soil shows the following layers: (1) 0 to 7 inches, brown mellow silt loam or loamy silt; (2) 7 to 18 inches, light-brown or yellowish-brown mellow loose-structured silt loam or loam; (3) 18 to 21 inches, buff or bright-brown, heavy slightly compact silt loam; and (4) 21 to 40 inches,

light-brown silt loam. Soil of this phase is characterized by the fairly uniform texture and structure of the different layers, although the surface soil is a little spotted in places where gravel and pebbles are mixed with it. The subsoil has some degree of compaction, but it is not heavy and tight as in typical Dunkirk silt loam. The other layers are mellow and of moderately loose structure.

This soil has a small total area and occurs in a few widely scattered bodies. It is all used, either for general field crops or for orchards. It is a good soil for orchards, and about 40 percent of it is utilized for this purpose. The soil is managed and treated like typical Dunkirk silt loam, but yields average somewhat lower.

Dunkirk loam.—Dunkirk loam includes areas in which the soil shows little uniformity in the texture of the surface soil and in the arrangement of the subsoil layers. Essentially it is a combination of Dunkirk silt loam and Dunkirk fine sandy loam that occurs in a spotted intricate pattern, together with areas having no definite soil profile. In some spots, the 6- or 8-inch surface soil of brown- or grayish-brown silt loam is underlain by light-brown fine sandy loam that rests on buff heavy silt loam or silty clay loam. In other spots gravel is mixed through the soil. Some areas have a surface layer of brown silty loam over light-brown or yellowish-brown fine sandy loam which gives way below to moderately tight heavy brown clay. The substratum of Dunkirk loam consists of bedded layers of light-brown or grayish-brown sand and silt, with a smooth floury feel.

The total area of this soil is not large, and the individual areas are small. Most of the soil is in the northeastern part of Kendall Town. Other bodies are in the northwestern part of the county.

All the land is farmed and some intensively so. It is easily cultivated and in general holds sufficient moisture for the demands of crops. Parts of it are included in the section occupied by the larger commercial fruit orchards. Apples are the chief orchard fruit, and peaches, plums, and cherries are of secondary importance. For general farm crops the land is handled in the same manner as is Dunkirk silt loam.

Dunkirk gravelly loam.—Dunkirk gravelly loam is one of the most irregularly developed soils in the county, as it is characterized by abrupt, intricate changes of texture and structure of the several layers, that cause a complexity impossible to separate or delineate on a soil map. In cultivated fields, the topmost layer, in general, consists of medium dark brown or grayish-brown gritty gravelly loam, but it has inclusions of light loam, fine sandy loam, and silt loam and changes from one texture to another without any definite system. Variable quantities of rounded pebbles, gravel, and small flat angular rock fragments occur in the surface layer. The subsurface layer, at a depth ranging from 7 to 9 inches, includes light-brown, yellowish-brown, or yellow material which is similar to the surface layer in texture. It extends to a depth ranging from 14 to 22 inches and in most places is underlain by a layer of gravelly, pebbly, or cobbley material, in different stages of development and mixed with unconsolidated silt and sandy material. The stony fragments are held in a compact, firm mass, largely by fine soil material and

the iron compounds formed in the process of decomposition. The color of the gravelly layer is bright brown or light reddish brown, and it is influenced in part by the decay of the red sandstones and red shales that are abundant in the layer. The texture includes gravelly loam, sandy clay loam, and clay loam. The mass of gravelly material shows some stratification and is interbedded with sands and silts. The material just above the heavy material, as clay loam, shows some staining of gray and yellow. The irregular gravelly layer is one outstanding characteristic of this soil. It is more or less intermittent but in most places is continuous for long horizontal distances. Below this, at a depth ranging from 28 to 35 inches, are stratified layers of fine sandy loam, loamy fine sand, or silt loam, which are brown, light brown, or brownish gray. The thickness of these layers ranges from thin seams one-fourth to 1 inch thick to more pronounced strata from 5 to 10 inches thick. The soil material extends to bedrock of red shale and sandstone, which lies at a depth ranging from 8 to more than 12 feet.

The surface soil of Dunkirk gravelly loam contains a moderate quantity of organic matter. Scattered over the surface and through the surface soil and subsoil are many small and medium-sized stony fragments, some of which are rounded, but they include a large proportion of flat angular stones ranging from 2 to 4 inches in diameter. The subsoil is very gravelly in most places, and the material composing it is derived mainly through decomposition of this gravel. The stones are a mixture of red and gray sandstone and shales, together with limestone, granite, and crystallines. Decomposition of this mixed material has produced materials of different fertility and texture. The thickness of the subsoil, which ranges from about 8 to 40 inches, is an outstanding characteristic of this soil. The layers that make up the substratum are somewhat compact, and the silt and sandy layers contain only a small quantity of gravel, most of which are about the size of small pebbles.

The upper layers are slightly acid, but the reaction in layers of the substratum is variable, in places being acid and a few feet away neutral or alkaline.

Both surface and internal drainage are good. The soil readily absorbs sufficient moisture to meet ordinary plant requirements, and the amount retained is influenced by the character of the soil layers.

Dunkirk gravelly loam occupies ridges elevated high above the general level of the surrounding country. The land is smooth or slightly undulating, with moderate slopes on the sides of the ridges. The largest development of this soil is in the western part of the county. The bodies are scattered but have a fairly large total acreage.

This soil is considered excellent for the production of fruit, and a number of high-producing orchards are established on it. Most of the orchards consist of apple trees, but some peaches, plums, and cherries are included. Some dairying is carried on in conjunction with general farming operations. Vegetables, including peas, tomatoes, cabbage, and sweet corn, are grown by contract for canning companies or for market. A crop rotation commonly practiced consists of beans, corn, or potatoes, followed by oats or wheat, and these by clover and timothy. Wheat yields from 20 to 40 bushels

an acre, oats as much as 75 bushels, corn 50 to 90 bushels, and beans 12 to 20 bushels. The popular commercial fertilizer mixtures used are 2-8-10, 5-10-5, and 2-12-2.

Dunkirk gravelly loam is one of the more productive soils of the well-drained group and compares favorably with the high-grade lands of the county.

Included with this soil as mapped is a small development near Holley, in which the soil is loam instead of gravelly loam. Here the soil is very irregular in its development and includes narrow depressed areas which show mottles of gray and yellow, produced by inadequate subsoil drainage. In the slight depressions, the surface soil is darker than typical and the texture more silty. The lower layers are somewhat stained with gray and yellow.

A variation of Dunkirk gravelly loam as mapped has a surface layer of dark-brown or grayish-brown gravelly silt loam that grades, at a depth ranging from 7 to 9 inches, into a subsurface layer of light-brown or brown gravelly silt loam which is somewhat compact in the lower part. At a depth ranging from about 18 to 21 inches, this material rests on the subsoil which consists of reddish-brown or deep rich-brown gravelly or pebbly clay loam derived in large part through decomposition of the stony fragments contained in the layer. The rounded stones range in size from that of a pea to that of a lemon or slightly larger. The subsoil, which ranges from 15 to 35 inches in thickness, is slightly plastic when moist, and small masses of it are slightly cemented, but when dry it breaks to a friable mass. It is abruptly underlain by brown or light chocolate-brown tight smooth calcareous clay stained with gray and yellow. The differences distinguishing this soil from typical Dunkirk gravelly loam are the heavier texture of the surface layer and the heavy development of the subsoil. It is a stronger soil than the typical soil but is of small extent. The land is used chiefly for orchards, in which the fruit trees are healthy, vigorous, and produce a high average yield.

Some included areas have a 6- to 8-inch surface layer of medium dark brown or grayish-brown gravelly silt loam or silty loam, which grades into light-brown friable gravelly silt loam. This material, in turn, is underlain at a depth ranging from about 14 to 18 inches by a characteristic reddish-brown, deep rich-brown, or light brownish-red gravelly or cobbly clay loam having a moderately compact structure and extending to a depth ranging from 25 to about 50 inches. Below this depth are layers of irregularly stratified material having no orderly arrangement as regards position, texture, thickness, structure, and length. In general, they comprise a series of alternating strata consisting of brown, brownish-gray, rich-brown, or pale grayish-brown smooth silt loam interlaminated with clay and sandy layers. At lower depths are light-brown layers, ranging in thickness from a few inches to 12 inches, of compact loamy fine sand interbedded with pale reddish-brown fine sandy loam.

Dunkirk fine sandy loam.—In its typical development, Dunkirk fine sandy loam is composed of the following layers: (1) Light-brown or grayish-brown fine sandy loam containing some organic matter that imparts a loamy feel; (2) yellowish-brown or brownish-yellow smooth loamy fine sand or fine sandy loam extending to a

depth ranging from 14 to 18 inches; (3) deep-brown or buff silty clay loam having a close compact structure, and in places heavy tight silt loam; and (4) light-brown or brownish-gray fine sandy loam stratified with smooth floury silt loam and in places with silty clay loam, the finer interstratified materials, such as clay and silt, being calcareous at less depth than the sandy material in places.

Dunkirk fine sandy loam occupies a very small total acreage in the northeastern part of the county. Like the other soils of the lakeplain section, it has flat, wavy, or broadly undulating relief, broken by narrow winding depressions. Drainage is well established.

All the land has been cleared of the forest growth, and about one-half is planted to orchards. The rest is used for the growing of such crops as wheat, oats, beans, corn, barley, clover, timothy, and vegetables that include cabbage, tomatoes, beans, and peas. Yields average only a little less than those obtained on the associated Dunkirk silt loam.

SOILS WITH COMPACT SUBSOILS

Clarkson loam.—A characteristic feature of Clarkson loam is its bright color. This soil has been strongly influenced by the decomposition of red shales and sandstones, which are abundant and are derived from formations beneath it. The following well-defined layers are characteristic of this soil: (1) The surface layer, about 7 inches thick, of grayish-brown gritty loam or silty loam, which grades in places toward very fine sandy loam; (2) the subsurface layer of light-brown, yellowish-brown, or yellow friable loam that continues to a depth ranging from 11 to 15 inches; (3) a transitional layer of fine sandy loam or loam which rests on the subsoil and is irregularly developed, ranging from 1 inch to 4 inches in thickness, and includes a mixture of shades of yellow, gray, and brown, with mottles of rust yellow and rust brown distributed through the soil mass; (4) a compact heavy soil material consisting of brownish-red, brown, reddish-brown, or buff light clay loam or silty clay loam, which when disturbed is friable but on drying becomes hard; and (5) at a depth ranging from about 20 to 26 inches, the substratum of light reddish-brown, pinkish-brown, or salmon-colored friable unsorted fine sandy loam and loam.

Throughout the soil mass are stony fragments of red shale and sandstone, gray stones of similar texture, also granites and crystallines. The fragments are flat, angular, or subangular cobbles and boulders, with a maximum diameter of 2 feet, but most of them are only a few inches in diameter. They do not occur in sufficient quantities to hinder tillage operations.

The surface layer is porous and well drained, but downward percolation is retarded by the compact subsoil; consequently, a thin moisture belt forms on top of it, which has produced the mottled third layer of the soil. In some small areas this layer is not developed, and in such places the subsoil is more friable.

Clarkson loam occurs principally in a number of areas through parts of Albion, Murray, and Gaines Towns, and small isolated bodies are in other parts of the county. Developments in the southern part contain a higher proportion of limestone fragments and are more friable in the subsoil. These bodies occupy transitional belts

bordering Ontario loam. In the lake plain, north of the ridge road, some of the conspicuous small knolls and ridges are occupied by this soil.

Clarkson loam is an important farming soil and is moderately extensive. It lies within a well-developed section that supports a large proportion of the population. About 90 percent of the land is cleared and farmed, and the rest consists of wooded slopes and scattered wood lots. Nearly all of it has a relief suitable for cultivation, and there is little waste or abandoned land. This is considered a productive and suitable soil for general cropping as well as for tree fruits. All crops commonly cultivated in the county are grown on this land. Wheat, oats, corn, and hay are the important general farm crops, and tomatoes, beans, cabbage, and peas are the principal vegetables. Practically all the hay and grain is fed to livestock, but vegetables are cash crops. In general, the yields obtained are in excess of the average for the county.

Commercial fruit growing is a well-developed enterprise on this soil and is the chief source of revenue on a large number of farms. Most of the orchards are carefully managed. Clean cultivation with cover crops and fall plowing are practiced by some orchardists, but a few follow a sod-mulch system. The trees are periodically pruned and sprayed. Fair yields and high-quality fruit are obtained. As an indication of yield, one farmer reported an average annual yield of 2,000 barrels from a 35-acre apple orchard including Wealthy, Oldenburg (Duchess), Rhode Island Greening, and Baldwin trees.

In addition to manure, commercial fertilizers are used rather extensively on all the farms. The mixtures most favored are 2-8-10, 5-10-5, and 4-16-4, and acre applications range from 150 to 400 pounds for general crops. Superphosphate and nitrate of soda are used separately. Cabbage commonly receives an application of 2-8-10, but no general rule is followed for the use of the different mixtures for particular crops, the mixture used depending largely on the farmer's inclination and experience in the use of fertilizer. Sodium nitrate is applied to fruit trees at a rate dependent on the size and age of the individual tree.

Farms on this soil are well managed, have good equipment, and are improved with comfortable farm dwellings and adequate barns. The fertility of the soil compares favorably with that of Ontario loam.

Closely associated with Clarkson loam are areas of poorly drained Hilton loam. These two soils are farmed together and on many farms are utilized for the same crops.

Gravelly loam areas included with Clarkson loam in mapping resemble it in color, texture, structure, and arrangement of the several layers but have a large content of unassorted stony material. Most of the stones are small, having a maximum diameter of 4 inches. Many of them are flat angular fragments derived from red sandstone and shale formations, but some boulders and small rounded gravel of crystalline rock and granite are included in the mixture. Although many fragments have been removed from some fields, large quantities still remain. The gravelly material is more abundant in some places than in others, and some fields are maintained in pasture because of the prevalence of stones. The stones are not

large enough, as a rule, to prevent the use of the larger farm implements, but the quantity is sufficient to cause inconvenience with small tools.

The total area of these included gravelly areas is not large. The several bodies are associated with the typical soil, and a number of them are farmed and utilized for the same crops as those grown on the typical soil. Commercial orchards are planted on some areas, and the trees thrive as well as on the less gravelly areas. The crop rotations followed and yields obtained are similar to those on the typical soil.

Some silt loam areas included with Clarkson loam as mapped have a 6- or 8-inch surface layer of medium dark brown or grayish-brown mellow silt loam or silty loam. The subsurface layer is of similar texture but of granular structure and of somewhat lighter color. The lower part of this layer is somewhat stained with rust brown, yellow, and gray. In a few places the material alternates, horizontally, with a 2- or 3-inch stratum of light yellowish-gray or gray firm silt loam mottled with yellow. It is abruptly underlain by light reddish-brown or deep-brown silty clay loam which is coherent and firm enough to retard the downward percolation of ground water. The basal layer is largely a mixture of light-textured materials which are pinkish brown, grayish brown, or faint reddish brown.

The color, structure, and development do not differ materially from these features of typical Clarkson loam, the outstanding difference being the larger quantity of finer soil particles in the upper part. Like the loam this included soil contains fragments of sandstone, shale, and granite, but the stones are not abundant enough or of sufficient size to interfere with tillage operations. Some fields are surrounded by stone rows or fences which are built from stones collected from the land.

The included areas of Clarkson silt loam are developed mainly in Yates and Ridgeway Towns, and small bodies occur elsewhere. Although the areas are not large, a number of fields are made up of this soil, and a number of farms are composed of this soil in association with other Clarkson soils, Dunkirk silt loam, Lucas silt loam, Hilton silt loam, heavy-subsoil phase, and Ontario loam. Along boundary lines where this soil grades into adjoining soils, color and structural differences develop. Clarkson silt loam is a moderately strong and fertile soil and produces slightly higher average yields than Clarkson loam under similar systems of management.

Clarkson fine sandy loam.—The surface soil of Clarkson fine sandy loam, to a depth of 6 or 8 inches, is light-brown or grayish-brown fine sandy loam having a brownish-gray cast when dry. This grades into brownish-yellow or yellowish-brown material of similar texture. At a depth ranging from 12 to 15 inches the material is somewhat stained with rust yellow and gray, or there may be a light-gray 1- to 3-inch sandy layer containing streaks of yellow. Beneath this is light reddish-brown or buff rather firm and compact sandy clay loam. The substratum, which occurs at a depth ranging from 25 to 30 inches, is unassorted pinkish-brown or grayish-red loamy material.

This soil is closely related to Clarkson loam, but the surface soil consists of more sandy and looser material and ranges in texture from

fine sandy loam to sandy loam or loamy sand. The subsoil and substratum are similar to the corresponding layers of Clarkson loam.

Clarkson fine sandy loam occurs in small widely scattered bodies and is associated with Clarkson loam. Along the boundary lines indicated on the soil map are narrow transitional strips of more or less loamy texture. The upper part of this soil is porous, owing to its sandy character, and rain water drains rather rapidly through it, but the subsoil is not so readily drained as it has greater absorptive capacity and retains moisture better. The sandy layers of the soil are acid, and the growth of legumes is sparse unless the land is treated with fairly heavy applications of lime. The lower layers, however, are sweet, or alkaline.

This soil is used for general farm crops. It is not cultivated separately but is farmed in connection with surrounding soils, and, in general, treatment and management of the several soils are similar when planted to the same crop. Some farmers may apply larger quantities of manure to individual spots of this soil.

Included are some gravelly areas which are similar to the rest of the soil, except that they have a larger content of stones throughout the soil mass and a slightly coarser texture in spots. In color, structure, and thickness of the corresponding layers the gravelly soil is much like the gravel-free soil. Small flat angular stones cover the soil and are fairly abundant throughout the layers. The fragments differ in size, but only a few of them exceed 4 inches in diameter. The areas of gravelly soil are unimportant and inextensive. The larger developments are in the eastern part of Carlton Town, where they occupy small knolls and narrow low ridges. Nearly all of this gravelly soil is cleared and devoted chiefly to the production of grains and hay, although some of the more gravelly areas are maintained in pasture for a number of years or lie fallow. Crop yields correspond to those obtained on the gravel-free soil, but they average lower than yields on the heavier textured Clarkson soil. The land is easy to prepare and till and can be worked soon after a rain. It warms earlier in the spring than does the heavier textured Clarkson soil. Crop growth is spotted and irregular, according to the depth of the sandy layers and differences in the subsoil. Yields are influenced by seasonal factors of rain or drought.

SOILS WITH SHALLOW SUBSOILS OVER ROCK

Medina silt loam.—Medina silt loam is a well-drained shallow soil consisting of deposits of soil material on high benches, or terraces, which are no longer subject to overflow. The surface soil is brown or grayish-brown gritty silt loam or loam, extending to a depth ranging from 8 to 18 inches, but in most places this layer is no thicker than 12 inches. In some places the color is brownish gray, and in others it has a red tinge. Small boulders, 1 foot or less in diameter, and gravelly material are fairly abundant and disseminated irregularly through the surface soil. The surface soil is underlain abruptly by a layer of medium-brown or light reddish-brown fine smooth clay, from 2 to 6 inches thick, which has decomposed from the underlying red shale rock. Small areas of loam and even of sandy loam are included with this soil as mapped.

Medina silt loam occupies a series of narrow high benches, lying one above another, along several of the streams. The relief is practically level, although a few narrow irregular depressions several feet wide, which represent former waterways, are included with the soil as mapped. The larger areas are in the valleys of East Branch Sandy Creek and Oak Orchard Creek north of Medina.

This land is used chiefly for pasture. Some is forested, and a scattered growth of thorn apple and brush is spreading over some pasture fields. A few small patches are used for field crops, and some alfalfa has been successfully grown in several places. There are several small orchards on this soil, but they contain many open spaces where trees have been removed or have died. Some orchards show evidence of neglect. Yields of fruit and general crops are small—less than the average for the county.

Dunkirk gravelly loam, shallow phase.—Small areas of the shallow phase of Dunkirk gravelly loam occur, in which the soil characteristics are like those of typical Dunkirk gravelly loam, but the soil material rests on red shale at a depth of less than 50 inches. The various soil layers correspond to those of typical Dunkirk gravelly loam, but they do not have the same relative thickness. The soil occurs in scattered areas on high narrow benches along some of the larger streams. Some bodies are farmed with adjoining soils for field crops, others are planted to orchards, and still others are used for hay or pasture. Fruit trees do not produce so heavily as on the typical soil, nor do trees of the same age attain the same size. Yields of field crops are good but, on the whole, less than on the typical soil.

Clarkson loam, shallow phase.—The 6- to 8-inch surface layer of the shallow phase of Clarkson loam is brown or grayish-brown gritty silty loam or loam, in some spots silt loam. This material merges into a layer of lighter colored material. At a depth ranging from 14 to 18 inches, there is an irregular development of grayish-yellow or gray loam stained with rust yellow, constituting a thin transitional stratum between the lower part of the surface soil and the heavier subsoil. This is abruptly underlain by the subsoil, at a depth ranging from 18 to 22 inches, which is light reddish-brown or deep rich-brown gritty clay loam or silty clay loam, sufficiently coherent to be slightly compact in place. This condition is more evident when the material is dry than when it is moist. At a depth of about 28 or 30 inches is a light reddish-brown gritty gravelly mixture of silt loam, fine sandy loam, or light silty clay loam.

The outstanding feature that differentiates this soil from typical Clarkson loam is its comparatively slight thickness. At a depth ranging from about 40 to 50 inches, the material grades into reddish-brown silty clay loam or heavy silt loam, which rests on bedrock of shale, or "red horse." In local spots the bedrock shale is reached at a depth of about 5 feet. The thickness of the several layers differs from place to place, but the layers correspond to those of the typical soil, although the color is, in general, of deeper shades, particularly in narrow strips occurring in well-drained places along streams or ridges.

The largest area is an irregular narrow belt along Sandy Creek, and small isolated bodies, a few acres in size, are mapped in the northeastern part of the county. The land is well drained and well

aerated. This soil is not important agriculturally because of its small total area.

Parts of this soil are utilized, in connection with the surrounding soils, for general farm crops, canning crops, and orchard crops, and some of the land lies idle or is kept for pasture. The soil is not considered so desirable or so productive as the typical soil, and crop yields are lower, in some seasons being below the average for the county.

Farmington silt loam.—Farmington silt loam is a variable soil showing pronounced differences that, within short distances, are reflected in crop yields. It consists of materials derived largely from underlying limestone, that rest at irregular slight depths—usually less than 40 inches—on limestone formations. The surface soil is medium dark-brown or grayish-brown gritty silt loam merging, at a depth of about 8 inches, into brown or light yellowish-brown granular silt loam. At a depth ranging from 12 to 24 inches is an irregularly developed layer which is heavier textured than the upper layer of the soil. It consists of alternating lenses or projections of heavy silt loam, silty clay loam, or light clay loam, of various shades of deep brown and having either a compact and tight or a friable structure. Some of the material in the lower part of the layer is faintly stained with gray and yellow. At a depth ranging from 18 to 40 inches are indurated limestone formations. Locally the soil material extends to a depth ranging from 5 to 7 feet, but within a few feet it may be less than 3 feet thick. Gravel and some small fragments of limestone and other rocks are mixed through the soil, but in no place do they interfere with cultivation.

This soil is well drained, and the shallow parts are inclined to be droughty. The main bodies occur in Shelby and Barre Towns, where they form an intermittent belt between soils derived largely from the red sandstones and shales on the north and those influenced by limestones on the south.

The deeper parts of this soil are suitable for cropping. Alfalfa succeeds, but the growth is not heavy, owing to the thinness of the soil material. A large part of the land is used for hay or pasture fields, and selected spots are planted to corn, wheat, oats, and vegetables. Some apple, pear, and peach orchards have been established and are in moderately good condition considering the shallowness of the soil. Yields are only fair, that is, they are below the average for the county.

Farmington loam.—Farmington loam includes light-textured shallow soil material directly overlying calcareous sandstone. In most places the depth to bedrock averages about 10 inches. This soil is medium dark brown loam grading beneath into light-brown or brownish-yellow loam. The material is sweet from the surface down. It is a dry soil, owing to its open structure and slight depth.

This soil is of small extent and is confined mainly to a few small bodies in the east-central part of the county. It is considered an undesirable soil for cultivation, and most of it lies fallow or is in pasture, although a few selected areas are farmed to general crops in connection with adjoining soils. Some vegetables are grown on small acreages, but yields are low and the plant growth is poor. The most effective use of the soil is as pasture.

SOILS WITH FRIABLE SUBSOILS AND LOOSE SANDY OR GRAVELLY SUBSTRATA

Alton coarse sandy loam.—Alton coarse sandy loam, as developed in this county, consists of the following layers: (1) A 4- to 8-inch layer of light-brown or light grayish-brown gritty loamy sand with inclusions of sandy loam, loamy fine sand, or coarse loamy sand, containing a small quantity of organic matter, which produces dark shades in places, also some admixture of fine gravel and small pebbles; (2) brownish-yellow or yellow loose porous sand, loamy sand, or coarse loamy sand, which differs from the surface soil chiefly in its lighter color; (3) bright-brown or light reddish-brown gravelly sandy loam, slightly cemented in places, occurring as a thin uneven horizontal stratum which, in places, has fingerlike projections extending into the underlying material; and (4) the basal layer, or substratum, consisting of gray strata of rounded gravel, pebbles, and coarse, fine, and medium calcareous sands, some of which are firmly cemented into large masses by lime carbonate which forms a white coating over the particles. The gravel is water-deposited material derived from sandstone, shales, limestone, and granite.

In a few places, the wind has heaped fine sandy materials in small mounds which are devoid of vegetation. Gravel pits have been opened in a few places, and the gravel is utilized in road construction.

The upper layers of the soil are moderately acid, and this condition continues downward to the lower part of the subsoil, below which the material has a sweet, or calcareous, reaction.

The relief is smooth, undulating, gently sloping, or ridgy. Water circulates rapidly through the soil material, owing to the sandy texture and open structure. This is considered a dry soil, and measures to conserve moisture are necessary.

Some of the soil occurs in scattered areas in the southern part of the county, but the largest development is on the low ridge extending across the central part in a nearly continuous belt. A few bodies are in Murray Town near Holley.

Nearly all of this soil on the ridge is given over to fruit production or to building sites for homes of the large population concentrated along the ridge road. Fruit trees of all kinds have maintained a healthy and productive growth for a long period, some apple orchards in this locality being 75 or more years old and still producing good crops. Elsewhere this land is utilized for growing fruit, wheat, potatoes, oats, hay, and vegetable crops. Yields are only fair, although the farming methods followed are good. This soil is recognized as being of only moderate fertility and more suited for specialized than for general farm crops.

Alton gravelly loam.—Alton gravelly loam consists of the following layers: (1) About 8 inches of medium-brown gravelly light loam, with a large quantity of rounded gravel of a maximum diameter of 4 inches scattered over the surface; (2) between depths of 8 and 21 inches, light-brown or light yellowish-brown gravelly light loam with thin interbeddings of loose gravelly loamy sand in places; (3) from 21 to 26 inches, bright-brown or reddish-brown gravelly light clay loam, which is more or less cemented or compact and when moist has a somewhat red cast, occurring as an irregular wavelike stratum and in places having narrow tongues extending downward into the substratum; and (4) from 26 to 50 inches, stratified layers of gray

gravel and sand, in which some cementation of the material has taken place and some of it shows white coatings of lime. In most places the gravelly substratum extends to a depth ranging from 10 to 25 feet or deeper, but in a few local spots red shale rock is reached at a depth ranging from 4 to 5 feet.

This soil is associated with Alton coarse sandy loam, mainly in the eastern part of the county, where its position and relationship indicate that its origin was due to water action, with some later mixing by ice action.

The surface and subsurface layers are slightly acid, but the lower part of layer 3 in most places is sweet, and the substratum is calcareous. The separation of this soil from the coarse sandy loam is made on the bases of the higher content of silt and gravel, greater moisture-holding capacity, and relatively higher fertility. The relief is smooth, undulating, or gently sloping, but in places the soil occupies a few elongated narrow ridges. Surface drainage is thorough and internal drainage good.

All this land is in farms and is cultivated with the adjoining soils. A few small apple orchards are located on the higher elevations or ridges, and in such positions the trees appear to be in good condition. Some grapes also are grown. Yields of field crops vary over the same field, the differences in growth being influenced by differences in soil fertility, but the average yields approximate about the average for the county.

The principal use for this soil is for the production of apples and other tree fruits. The field crops comprise corn, wheat, oats, some barley, and hay. Small patches of alfalfa have been successfully established. Beans, cabbage, tomatoes, and peas are important cash crops, and some beans, potatoes, and some other vegetables are intertilled in young orchards. This is not good pasture land on account of the sparse grass cover it supports. This soil ranks as medium-grade land for field crops and is moderately good for orchard fruits.

Some included soil is characterized by the open, loose structure of the surface soil and the light-textured materials of the subsoil. No definite arrangement is developed as to the thickness of the layers or their texture. Considerable rounded, angular, and flat fragments of sandstone, shale, and other rocks are mixed through the soil.

This included soil is well drained and tends to be dry. It occurs mainly on narrow intermittent small ridges, and some bodies have an undulating relief. In general, the surface soil consists of grayish-brown, brown, or brownish-gray light mellow loam, loamy fine sand, or fine sandy loam, to an average depth of about 7 inches. Below this the material is lighter in color, including shades of brown and yellow, and the texture is similar to that of the surface soil. At a depth ranging from about 15 to 20 inches, the material grades into a layer of mixed grayish-yellow, pale-yellow, or light brownish-yellow loamy sand or fine sandy loam, containing an assortment of materials that are somewhat heavier in texture than most of the material in the layer. The heavier material includes moderately compact sandy clay loam, lenses of reddish-brown heavy fine sandy loam cemented into a firm mass, or pockets of smooth brown silt loam or silty clay loam stained with yellow and gray. The lighter sandy-textured material also develops some staining which is most noticeable in a thin layer

above the heavier material. The substratum contains stratified layers of sand in some places and in others is a heterogeneous accumulation of sand, silt, and clay.

Otisville gravelly loam.—Otisville gravelly loam, to a depth of 4 or 6 inches, consists of medium deep brown or grayish-brown loam. It grades into light-brown or yellowish-brown light loam of moderately loose porous structure. At a depth ranging from about 20 to 24 inches, this material changes to a mixture of light reddish-brown coherent gravelly or cobbly heavy loam and fine sandy loam. No regularity of texture or color is developed. The layer is comparatively thin and gives way, at a depth ranging from 30 to 34 inches, to a grayish-yellow, yellow, and yellowish-brown heterogeneous mixture of light loam, sand, boulders, cobbles, and gravel, containing thin irregular strata of reddish-brown fine sandy loam. In places, the texture of the surface soil is sandy loam or fine sandy loam.

This soil shows little orderly arrangement or regularity of texture, depth of layers, and structure. For the most part the material is porous, very friable, only moderately coherent, and normally has an acid reaction to a depth of many feet. This last-named condition is a characteristic feature of Otisville gravelly loam which distinguishes it from Groton gravelly loam. Throughout the soil mass and scattered over the surface are irregular accumulations of hardheads (large boulders), cobbles, gravel, and angular broken fragments of flat small stones, derived from gray sandstone, red sandstone, gray shale, red shale, granite, and crystalline rocks. In some places the rocks are sufficiently numerous to hinder cultivation.

The relief includes an irregular arrangement of knolls and ridges with steep slopes that encircle small depressions or pockets. Because of its texture and open structure the soil tends to be dry, although moisture is retained in the depressions for a long time.

This soil is not important agriculturally, on account of its small extent. It occurs chiefly in Clarendon Town, and a few small areas are in other parts. Nearly all of the land has been cleared of the forest growth, and only a very small acreage is cultivated, as the inequalities of relief make the land unsuitable and undesirable for farming. Most of it is in permanent pasture for sheep and other livestock. The few acres farmed are used for general crops, but yields are low and crop growth is spotted because of differences in the soil within short distances. Orchard trees do well and, where properly managed, have a healthy growth, but the yields of fruit are strongly influenced by methods of fertilization and management. Under prevailing economic conditions and because of the presence of more productive soils in the same locality, land of this character is more suitable for the growing of timber or for pasture.

Groton gravelly loam.—The surface soil of Groton gravelly loam is brown or grayish-brown gravelly loam which gives way, at a depth ranging from about 4 to 8 inches, to lighter brown material of similar texture. Both layers contain small or medium-sized rounded gravel or pebbles that make up a large proportion of the soil material. The subsoil, between depths of 12 and 20 inches, is a comparatively thin but conspicuous stratum of light reddish-brown, deep-brown, or buff compact gravelly light clay loam resting, at a depth ranging from 30 to 40 inches, on compact or lightly cemented interstratified

layers of calcareous gravel and sand. In places, the material is a thick heavy unassorted mass of gravel, boulders, and sand.

The soil is not of wide distribution. The relief is level or undulating in one locality and in another is characterized by long winding narrow ridges with steep slopes or a series of small knolls, hills, and knobs, without definite arrangement, surrounding small depressions or pot holes.

Groton gravelly loam is a droughty soil, as rain water percolates rapidly through it, and little moisture is retained. In dry seasons crops suffer from lack of moisture. The soil has a fair inherent productive capacity, and the same crops are grown as on other soils. Alfalfa is grown on a small acreage, and it yields from $1\frac{1}{2}$ to 2 tons an acre. Hay and pasture lands occupy the largest acreage, and wheat and oats are the chief grain crops. Corn is grown mainly for grain. Some is cut for silage. Beans and potatoes are grown on a small acreage, and some vegetables are produced for canning or for sale at markets. This soil ranks from good to medium for fruit trees, and some of it is planted to apples, peaches, and cherries.

Crop rotations are varied to meet the needs of individual farms. One rotation, followed where sod is turned under, is a tilled crop for 1 or 2 years, then the land sown to oats or wheat and a seeding of grass. Vegetables are grown in a rotation, followed by wheat or oats, then by mixed hay, and then by potatoes or corn. Acre applications of fertilizers are about 200 pounds of 5-10-5 for beans, 250 pounds of 2-8-10 for corn, and from 250 to 300 pounds of 2-12-2 for oats or wheat. Other methods are followed on different farms.

Yields of crops and the value of the cultivable areas are about the same or somewhat lower than on Arkport fine sandy loam.

Some areas included with this soil in mapping have a sandy loam texture and contain little gravel in the upper 18 or 20 inches, although some gravel occurs in spots on the surface. Small areas having loam and fine sandy loam textures also are included. These areas occur as small scattered bodies in parts of Clarendon, Murray, Shelby, and Baile Towns. The land is used for the same crops, but yields are slightly lower than on the typical gravelly loam areas, owing mainly to excessive droughtiness.

Arkport fine sandy loam.—The 4- to 7-inch surface layer of Arkport fine sandy loam is brown or grayish-brown loamy fine sand or fine sandy loam, which is underlain by yellow or brownish-yellow fairly loose loamy fine sand. At a depth ranging from about 12 to 15 inches, the material is light brownish-gray fine sand or fine sandy loam faintly streaked with gray. This layer, in turn, at a depth ranging from 20 to 25 inches, merges into a thin stratum, from 2 to 4 inches thick, of light reddish-brown or brownish-red compact heavy fine sandy loam. Below this is light grayish-brown or grayish-brown fine sandy loam containing irregular thin beddings, pockets, or lenses of gray very fine sandy loam and brown, light-brown, or light reddish-brown heavy very fine sandy loam or fine sandy loam.

The surface soil and subsoil layers are slightly acid, but the soil below becomes less acid, and at variable depths the material is sweet or calcareous. Alfalfa and sweetclover grow naturally and abundantly on exposed lower layers of this soil in road cuts.

The relief is irregular and broken, characterized in places by winding ridges, knolls, and depressions, and in other places by smooth or undulating land. Near Ashwood some of this land is called Little Alps because of its hilly relief. The sandy character of the soil allows good surface and internal drainage. The land is not considered droughty, as the heavy layers absorb the soil water and retard its rapid percolation.

This soil is fairly free of gravel and cobbles, though in places, particularly in the vicinity of Holley, it contains scattered gravel. Here the texture is coarser than typical, and the soil contains many fragments of red and gray sandstones. Cultivated spots or those denuded of vegetation are subject to shifting by the wind.

Areas of Arkport fine sandy loam are mapped in Clarendon, Albion, and Murray Towns. The largest developments are in the north-western part of the county near Ashwood and Lyndonville.

About 5 percent of the land is in farm wood lots, and the rest is devoted to a variety of crops and tree fruits. Some of the land is in one of the main fruit sections of the county, and a large acreage is covered by commercial orchards. This is considered a good fruit soil because of its well-drained position, friability, ease of handling, and productiveness. The main general farm crops are small grains, hay, beans, tomatoes, cabbage, and corn. These crops are well fertilized with applications somewhat heavier than those used on the loam and silty soils. The fertilizer mixtures commonly used are 2-8-10, 5-10-5, 2-12-2, and 4-16-20. The 2-12-2 and some 4-12-4 are used by some farmers at a rate ranging from 250 to 300 pounds an acre on land for oats or wheat. Some 2-8-10 is used for corn, tomatoes, and cabbage. About 250 pounds of fertilizer an acre are applied to grain and larger quantities to vegetables. Depending on their size and age, fruit trees receive from 3 to 5 pounds of a nitrate compound. The kind and quantity of fertilizer used differs on different farms, and farmers are influenced to a great degree by past customs.

Over the same field yields differ, owing to local influences of soil character, seasonal conditions, and type of management. Acre yields of corn range from 40 to 50 bushels, wheat 15 to 30 bushels, oats 35 to 60 bushels, beans 8 to 15 bushels, and cabbage 10 to 15 tons. Hay yields about 1 ton.

Dairying is an adjunct to other farm operations in some localities.

Most of the orchards are planted to apples and peaches, yields of which are good and the fruit well flavored and colored. Bush fruits and strawberries are grown for the most part in small patches.

This is one of the better grades of sandy soils, and conditions prevailing on farms composed of this soil are generally good.

Lack of uniformity in the soil is observed in exposures that present some color and textural variations within short distances. Spots of sandy loam and very fine sandy loam are included with the soil as mapped. In such areas the color shadings of the surface soil are brown, light brown, grayish brown, or brownish gray. The subsurface layer is porous and when dry tends to be incoherent, as it contains little fine material to bind the sand particles. The subsoil is an irregular mixture of loamy fine sand, fine sandy loam, or very fine sandy loam, each streaked with sandy material of lighter shades than

the base color. The lower layers contain heavy very fine sandy loam, fine sandy loam, or even fine sandy clay loam, of a characteristic red or reddish-brown color. This material lacks definite arrangement and may occur as a thin long stratum or as small lenses and pockets. The substratum is largely unassorted material and is lighter colored than the subsoil. In places it contains streaks, ranging from one-eighth to one-fourth inch in thickness of bright-brown heavy fine sandy material.

Also included with mapped areas of this soil are bodies of very fine sandy loam texture, which differ from the typical soil only in the finer texture of the soil material, which is characterized by a higher proportion of silt particles, but the color in the different layers and the structure are like those of the typical soil. Small spots of Ontario fine sandy loam also are included in places. This included soil is of only local agricultural importance as it occurs in but a few small bodies. The cleared land is devoted chiefly to the production of general farm crops, and yields are approximately the same as those on the typical soil. As this included soil is outside the commercial fruit belt, only a few small orchards are established on it.

Arkport fine sandy loam, smooth phase.—Arkport fine sandy loam, smooth phase, consists of medium dark brown or brown gritty fine sandy loam to a depth of 6 inches. This is underlain to a depth of 31 inches by light-brown, yellowish-brown, or brownish-yellow slightly loamy sand or loamy fine sand, which develops lighter shades of color in the lower part. Between depths of 31 and 34 inches are intermittent, irregular, thin, horizontal strata or lenses, together with pockets of light reddish-brown light fine sandy clay loam, heavy silt loam, or heavy fine sandy loam. In some places a few gray mottles occur in the material just above this layer. A cementing material binds the soil particles of this layer together sufficiently to resist pulverizing by slight force. In places several layers of this material are developed and form a part of the lower subsurface layer. Between depths of 34 and 45 inches is light brownish-gray or grayish-brown slightly compact or friable fine sand or loamy fine sand. Thin seams of light reddish-brown fine sandy loam similar to those in the layer above are interbedded in places.

For the most part, the texture of the surface soil is fairly uniform, but in a few places it is loamy sand or loamy fine sand. Silt and clay particles in the soil give some body to the material and aid in retaining soil moisture. The soil is porous and fairly coherent. The substratum is more or less stratified and has some interbedding of gravel and reddish-brown coarse sand and medium sand. The upper layers are acid but not strongly so. Below the brown cemented lenses the substratum is alkaline.

The sandy character of the soil allows rapid percolation of rainfall, but the land is not so dry as is Berrien loamy fine sand or Petoskey fine sandy loam, owing to the content of heavy sandy material which restricts percolation and absorbs considerable moisture.

Arkport fine sandy loam, smooth phase, occupies smooth or gently undulating country. The largest development is in the plainlike area in the vicinity of Lyndonville. One of the largest fruit-growing sections of the county is in this locality, and there are many commercial orchards on this soil.

With the exception of a few small scattered wood lots, all this soil is utilized for agriculture, most extensively for fruit growing. Most of the orchards include apple trees of commercial varieties, Baldwins and Rhode Island Greenings being most popular. Peaches are grown extensively, with Elberta as the favored variety, and plums, pears, and cherries are grown. The physical features and good drainage make this soil desirable for peaches and cherries. Trees are long-lived and healthy under normal conditions. Clean cultivation is practiced in many orchards. This aids in conserving soil moisture which is essential in a sandy soil. Cover crops of buckwheat, rye, and clover are grown in a large number of orchards. Fruit trees are fertilized with nitrate of soda and manure and are sprayed 6 or 8 times a season to control diseases and insect pests.

Arkport fine sandy loam, smooth phase, is used also for growing field crops, principally cereals, potatoes, hay, cabbage, tomatoes, peas, and beans. Alfalfa can be successfully grown. The crop rotation practiced includes hay for 2 or 3 years, followed by a cultivated crop of corn, potatoes, or beans for 1 or 2 years, and then by wheat, barley, or oats, seeded to grass.

This is one of the most desirable and fertile sandy soils in the county. Yields of general farm crops are moderate and about, or a little above, the average for the county. All crops are fertilized with 2-8-10, 5-10-5, 2-14-2, or 2-14-4 mixtures, applied in different quantities according to the experience of the farmer.

The greater part of the land in the fruit belt has a high selling value, because of its location and suitability for orchard fruits, but the value is less in other localities and is influenced by local economic conditions.

As mapped, the smooth phase of Arkport fine sandy loam includes small patches of Berrien loamy fine sand and Petoskey fine sandy loam, too intimately associated with this soil for separation, also areas having a very fine sandy loam texture.

Petoskey fine sandy loam.—In cultivated fields, Petoskey fine sandy loam is characterized by the following layers: A 7-inch layer of medium-brown or grayish-brown loamy fine sand or fine sandy loam, underlain, to a depth of 16 inches, by brownish-yellow, light-brown, or light yellowish-brown loamy fine sand or moderately loose fine sand. Between depths of 16 and 29 inches, the soil material is yellowish-brown loamy fine sand or fine sandy loam, containing small particles of slightly coherent material of similar color. Below this and extending to a depth of 51 inches, is pale-yellow or light grayish-yellow slightly compact loamy fine sand containing thin irregular horizontal seams of bright-brown heavy fine sandy loam material.

Some minor variations in color, texture, and thickness of the several layers are developed in this soil. Small local areas occur, in which the soil is coarser textured and contains fine pebbles.

The relief differs in different sections of the county, and the land includes ridgy, smooth, strongly sloping, undulating, and knolly country. Round and narrow depressions, only slightly lower than the general level of the land, occur in places. In depressions, the surface soil is thicker than typical, as surface wash from surrounding land has deposited fine sediments. The soil mass contains few stones,

gravel, or cobbles. It is acid to a variable depth, but in most places the upper part of the substratum contains some lime material.

The physical characteristics of the soil allow excessive internal drainage, and tillage to conserve moisture is important in order to prevent injury to crops from drought. Less soil water is retained by this soil than by Arkport fine sandy loam, smooth phase.

Petoskey fine sandy loam is associated with Arkport fine sandy loam, smooth phase, and differs from it in lacking the lenses of heavy material that occur in the subsoil of the Arkport soil.

About 10 percent of Petoskey fine sandy loam is forested with maple, hickory, basswood, hemlock, beech, poplar, and white oak. Fruit growing and general farming are practiced on the rest of the land. Fields of this soil or of this soil in association with other sandy soils are handled in a similar manner, though differences in results on the different soils are recognized.

Apples, peaches, and small fruits are grown. Fruit trees are in general well managed and are sprayed thoroughly for diseases and pests. With reasonable care the trees maintain a uniform normal rate of growth. The orchards are fertilized with commercial fertilizer and stable manure, and many farmers grow cover crops for plowing under. One farmer reported that 150 young peach trees produced an average of 600 bushels of fruit, and another reported that a 5-acre orchard of Baldwin and Rhode Island Greening apples yielded an average of 450 bushels a year over a period of 16 years.

General farm crops common to the section are grown with various results. This soil contains a limited quantity of plant nutrients and requires good treatment and the addition of amendments, in order to obtain yields that are average for the county. Some farmers have been successful in obtaining catches of clover and alfalfa. Vegetable crops produce well when fertilized heavily.

INTERMEDIATELY DRAINED SOILS

The intermediately drained soils have characteristics that superficially resemble the different features possessed by the well-drained soils. Their topographic position, however, together with elements within the soil material, has produced less suitable conditions for drainage than occur in the well-drained soils. The drainage difference alone, however, is not sufficient to prevent or seriously restrict utilization of the land. Drainage of these soils is seasonal and intermittent, and the accumulation of ground water results in a comparatively low water table that does not saturate the upper soil layers, although the quantity of water held by the soil material differs within short distances and is intermediate between that of the well-drained soils and that of the poorly drained soils.

These soils, as a group, do not have the same potential possibilities, in their natural condition, for general agricultural usage as do the better drained soils, because they are colder and wetter in the spring, thus delaying farming operations; they require artificial drainage in some places to remove excess water; and crops are subject to some injury from too much moisture during the growing period. Good drainage is very essential for best results in fruit growing, therefore these soils are less suited for this purpose than are the better drained soils.

A noticeable difference between the soils of the two groups is the darker color of the surface layer in the imperfectly drained soils, caused by a higher content of organic matter. Consequently they are of higher natural fertility. Oxidation is not so thorough in them, and the activities of the soil-development agencies are not so rapid in depleting the land of plant nutrients. In all the soils of this group, a mottled gray layer has been formed in some part of the solum, generally in the material resting on a heavier or more compact layer. This gray layer is largely the result of saturation by ground water and the leaching out of the soluble mineral elements. These soils are less acid, and the depth to the zone of lime concentration is much less than in the well-drained soils.

The texture of the soil material of the intermediately drained soils ranges from light sand to heavy clay. The structure or arrangement of soil particles in their subsoils is different in the different soils, as some subsoils are compact, tight, or cemented to form a hardpan, whereas others are friable. On the basis of these characteristics, several classes of soils are included in the group—soils with friable or moderately compact subsoils, soils with heavy underlying layers, soils with heavy but shallow subsoils over shale, and sandy soils.

Lucas silt loam and Schoharie silt loam are better drained than the other soils of this group and approach more nearly the well-drained soils in that they can be cultivated without artificial drainage.

The gray horizons of the Hilton and Collamer soils are not common to these soils, and, although there is some mottling above the heavy clay substrata, it is not so pronounced as in Schoharie silty clay loam or Hilton silt loam, heavy-subsoil phase.

SOILS WITH FRIABLE OR MODERATELY COMPACT SUBSOILS

Soils which have developed fairly heavy compact subsoils comprise a large subgroup of the intermediately drained soils. The surface layers consist of friable medium-textured materials and are adequately drained. The soil particles of the subsoil, however, are cemented into a sufficiently dense mass to restrict downward percolation of soil water. After rains a moisture belt is formed on top of the compact layer, and the material above the subsoil remains moist, whereas the subsoil itself is comparatively dry. During prolonged wet seasons, crops on these soils return poor yields, but, in dry periods, plants may respond better on them because of the greater moisture content.

Hilton loam.—To a depth of 7 or 8 inches, Hilton loam consists of medium dark brownish-gray or dark grayish-brown gritty friable loam or silty loam. This layer is underlain by gray or light-gray moderately firm gritty loam or fine sandy loam, containing irregular mottles of yellow and brown, which extends to a depth of 12 or 14 inches. Below this the material is light dull-brown or light reddish-brown light-textured clay loam or silty clay loam, which is compact in place and shows irregular streaking of rust yellow, gray, reddish brown, and pinkish brown. At a depth ranging from about 25 to 30 inches, the material is light grayish-brown, light bright-brown, or light pinkish-gray gritty fine sandy loam or loam, containing stains of light gray and rust yellow.

The surface soil is typically medium dark in color, owing to the incorporation of organic matter. When dry the immediate surface layer is somewhat gray, but when wet it is dark. The subsurface material is the distinguishing feature of this soil, as it shows evidence of the leaching of soluble material by soil water. As a result of this leaching, an irregular color layer has developed, differing considerably every few feet. In places it is ash gray with few mottles, whereas in others it is yellow or grayish yellow, faintly or strongly mottled with rust-colored material. In the subsoil, shades of brown and red change abruptly to yellow or grayish yellow, all which colors are variously splotched with yellow, brown, and gray mottles. The compact material in this layer crumbles to a friable mass when disturbed, but the structure tends to slow the downward movement of drainage waters. For the most part, the substratum consists of unassorted light-textured friable material, but in places it includes irregular stratified beds of silt loam and fine sandy loam. Large quantities of rock fragments are strewn over the surface and intermixed with the soil mass. The surface soil is slightly acid, but at a depth ranging from 15 to 20 inches the material contains some lime.

Hilton loam occurs in numerous moderate-sized areas, mainly in the eastern and central parts of the county, in association with Clarkson loam. Ontario loam, Hilton loam, and Clarkson loam have developed from the same kinds of material, but Hilton loam has developed under somewhat poorer drainage and occurs in flat or slightly undulating areas. Hilton loam and Clarkson loam together form a pattern in which Clarkson loam occupies the better drained land and Hilton loam the lower elevations where the Hilton soil receives seepage or drainage water from the Clarkson soil.

This soil has only local agricultural importance, but on some farms it is the principal soil. At least 95 percent of the land is cleared and is used for farming of some type. It is classed as a medium-productive soil and is farmed to a diversity of crops. The land makes a mellow seedbed when worked under proper moisture conditions, but if worked too wet it tends to become hard and bake. General farming prevails on this land, but activities are extended to include fruit growing and dairying. On many farms composed of Hilton loam and Clarkson loam, field crops are grown on Hilton loam, and Clarkson loam is planted to orchard fruits, although some commercial orchards are established entirely on Hilton loam and some extend to both soils. The largest acreage of Hilton loam, especially the stony areas, is used for hay or meadow land. The chief field crops are corn, wheat, oats, beans, tomatoes, potatoes, and cabbage, and yields are fair. Peas and tomatoes are commonly grown under contract for canning companies. Apples are the main orchard fruit, and Baldwin and Rhode Island Greening are the leading varieties. Pears and quinces are grown on a small acreage, generally in blocks ranging from 1 to 3 acres. On most farms, apple orchards receive intelligent care in spraying, pruning, fertilizing, and the sowing of cover crops. The condition of the apple trees is influenced by drainage, and in those sections of the orchard into which water seeps and accumulates, the trees have been removed or are in poor condition. Some orchardists improve the drainage by tiling, ditching, or ridging the land, and these improvements are

reflected in the appearance and vigor of the trees. The use of stable manure and commercial fertilizers for fruits and general crops prevails on this soil.

In places Hilton loam contains a larger quantity of gravel, cobbles, or stony fragments than typical. Large quantities have been removed from the cultivated fields, but many still remain. The stones range from small fragments about 1 inch in diameter to hardheads, or boulders, 2 feet in diameter, but the average size is about 3 or 4 inches. Most of the large boulders have been piled together in the field or placed in the bordering stone rows and fences. Although the cobbles offer some hindrance to easy tillage, they do not entirely prevent utilization of the land.

Where areas of Hilton loam are mapped in association with Ontario loam and occupy the smoother parts of the terrain, the depressions, or the lower parts of slopes, drainage is not so good or the areas are subject to seepage from surrounding soils. In such places the surface soil is mellow and has a higher content of organic matter than Ontario loam, to which it is closely related. The subsoil is not uniform in compaction and friability. It contains a larger quantity of lime in some form than does the subsoil of Ontario loam, and the substratum is calcareous. The texture and kind of materials are like those of Ontario loam. The principal differences from the Ontario soil are a more compact subsoil, less thorough drainage, and darker color. In places, Hilton loam and Ontario loam are so intermixed that different systems of farm management cannot be applied, and crops receive the same kind of treatment on both soils. Where conditions warrant, some fields are either tiled or drained by open ditches.

Hilton silt loam.—The 5- to 8-inch surface layer of Hilton silt loam is medium dark grayish-brown or dark brownish-gray gritty silt loam or silty loam. In some parts of cultivated fields the color is dull gray and in others is dull reddish brown. The subsurface layer is dull brownish-yellow silt loam, mottled gray and rust-yellow heavy loam, or gray silt loam containing a few yellow mottles, all materials being so intricately mixed that one predominates for only a few linear feet. The subsoil is definitely heavier textured than the upper layers. It consists of silty clay loam, fine sandy clay, or clay loam, which is compact in place, the compaction being developed most strongly in the upper part of the layer. The color ranges from dull shades of brown and buff to yellow, with some staining of gray, rust brown, and rust yellow. The color and texture of the substratum change somewhat within short distances, but both are lighter than in the subsoil. Most of the material is unassorted fine sandy loam and loam, but in places bedded material is included.

Gravel, cobbles, flat angular stones, and boulders are mixed with the soil material. The surface soil is heavier textured than the surface soil of Hilton loam, but in position and drainage the silt loam is like the loam. It is less extensive than the loam, and individual areas are widely distributed in the northern part of the county.

Farming practices on Hilton silt loam are influenced by the surrounding soils and are similar to those on Hilton loam. General farming is followed most widely. Only a few orchards are planted on Hilton silt loam, and most of these border areas where this soil

merges with better drained soils. Yields are slightly higher than on Hilton loam.

Small areas of soil included with Hilton silt loam in mapping differ from the typical soil in the more brown color of the surface and subsurface layers, slightly lighter texture, better aeration, and fewer mottles. Such bodies are developed on small knolls and ridges within areas of Hilton silt loam, heavy-subsoil phase, that are more thoroughly drained. The individual areas are a few acres in extent and are used for the same crops as areas of the typical soil. Quince, apple, and pear orchards located on this included soil respond better under similar treatment, and fewer trees are stunted in growth. Crop yields average slightly higher over a period of years.

Hilton silt loam, shallow phase.—In some parts of the county Hilton silt loam is comparatively shallow and rests on bedrock at a depth ranging from 3 to 4 feet. Such areas have been correlated as a shallow phase of Hilton silt loam. The general features, such as color, texture, and structure, are similar to those of the typical soil, but in some places the depth of each layer is less than the corresponding layer in the typical soil.

The relief is flat or gently undulating and is characterized by some short narrow ridges. The soil on these slightly higher elevations is deeper than the average and is more like typical Hilton silt loam. The underlying rock formation is red shale, the upper part of which has weathered and has produced a thin layer of reddish-brown clay that forms the lower part of the substratum.

This shallow soil occurs in both small and large bodies over the northern part of the county north of the ridge road. Some medium-sized areas are mapped in Gaines and Ridgeway Towns.

The total yield of crops is small. The few small scattered fields are utilized for such crops as oats, potatoes, beans, cabbage, and tomatoes. The acreage in pasture and woodland is probably more than 90 percent of the total. Some of the pasture fields have become overrun by weeds and small brush. Hay is cut from some fields, but much of it is of inferior quality.

Hilton fine sandy loam.—Hilton fine sandy loam has a surface layer of medium dark grayish-brown or brownish-gray light loam or fine sandy loam extending to a depth of 6 or 8 inches. This is underlain by a layer of grayish-yellow or light brownish-yellow fine sandy loam moderately splotched with rust-colored mottles. In places a gray color predominates. At a depth ranging from 12 to 15 inches, this material is abruptly underlain by the subsoil which consists of fine sandy clay or light clay loam, that is compact in place. The color of the material in this layer is a complicated combination of shades of brown, buff, and yellow, with rust-colored mottles. The substratum is pinkish-red or light reddish-brown fine sandy material. Scattered boulders, gravel, and subangular rocks of various origins occur on the surface and through the soil. The upper part of the soil is slightly acid and the lower part alkaline.

This soil occurs in small scattered areas, mainly in the northern part of the county, in association with other Hilton soils and Berrien loamy fine sand. The relief is fairly uniform, and drainage is slightly deficient in the lower part of the soil.

About 90 percent of the land is improved and used for general farming, and the rest is in brushy pasture or wood lots occupied by such trees as elm, maple, poplar, hickory, and ash.

Corn, oats, and hay are the principal crops. Acre yields of oats range from 30 to 40 bushels, corn 60 to 80 bushels, and mixed timothy-and-clover hay 1 to 2 tons. This is a minor soil on most farms and is responsible for a very small percentage of the farm income. The land is farmed, in conjunction with adjoining soils, to field crops and fruit.

Where this soil is developed in a few small widely scattered areas in association with the Ontario soils at the foot of slopes, in depressions or troughs, and in small strips bordering wet lands, surface drainage is adequate, but internal movement of soil water is slow because of the compact subsoil. Such areas are inextensive and of little agricultural importance. The soil is composed of materials similar to those in the light-textured Ontario soils, but their development has been hindered by poor aeration.

Collamer silt loam.—Collamer silt loam presents little uniformity in development. The material shows the influence of water assortment, but in some places the subsoil is an intricate mixture of unassorted materials. The surface soil is a combination of medium dark brown, medium dark grayish-brown, or brownish-gray smooth mellow silt loam 6 or 8 inches thick. This is underlain by brown or brownish-gray silt loam, with a moderate quantity of or no gray and yellow mottles, extending to a depth ranging from 10 to 18 inches. Below this depth the material is a mixture of dull yellowish-gray, gray, and grayish-yellow silt loam mottled heavily with brown and yellow. This layer has no uniform color development and abruptly overlies finer, heavier soil material consisting of bright-brown or light reddish-brown moderately compact but friable heavy silt loam or light silty clay loam, with an intermingling of gray, grayish yellow, and rust yellow, which extends to a depth ranging from 30 to 35 inches, where it is underlain by the substratum consisting of light grayish-brown or light-brown layers of fine sand, very fine sandy loam, and silt loam. Some of the substratum material is slightly compact, and above such material are pronounced gray and yellow stains. The material in other layers is well oxidized and aerated.

The soil has a low-ridgy, hummocky, or gently undulating relief. On the crests of the higher elevations, the soil material is characterized by the layers described above, but in the lower parts of slight slopes and in the flatter areas, the colors undergo a change and are affected by underdrainage. In such places the surface layer is more gray and the subsurface layer is mottled heavily with gray, yellow, and rust brown. The subsoil is dull brownish yellow or dull brown. The soil having these characteristics has a small content of gravel or stony fragments. The surface layers have good drainage, but the underground movement of soil water is somewhat slow because of the structure of the underlying layers. The highest parts of the soil have a lower water table.

Collamer silt loam is developed most extensively in the eastern part of Ridgeway Town, in association with the Fulton, Dunkirk,

and some other soils. Some areas are large enough to constitute the main soil on a farm, but many farms include several other soils.

Farming on this and the associated soils includes a combination of general farming, poultry raising, fruit growing, and livestock feeding. A small part of the land is reserved for wood lots. The combined acreage of hay and pasture lands covers the largest area. Some fields used for pasture for a few years are placed into a rotation of crops, and the general crops—hay, corn, beans, potatoes, oats, and wheat—are grown. Part of or all the tomatoes and peas are grown under contract for canning companies. Commercial fertilizers are considered important for the various crops, and the rate of application is the same for the different soil combinations. The three common fertilizer mixtures are 2-12-4, 5-10-5, and 2-8-10. Some superphosphate is used on corn and potatoes. Nitrate of soda is applied as a side dressing to vegetable crops and is also used in orchards. Crop yields are slightly lower than on Dunkirk silt loam but are slightly higher than on Lucas silt loam.

The section covered by this soil is a part of the main fruit belt of the county. Apples are grown more extensively than other tree fruits, and the combined acreage planted to peaches, cherries, pears, and quinces is small. Some parts of each orchard established on land of this kind show the effects of impeded underdrainage, as some trees are stunted, or retarded in growth, and are in marked contrast to those growing on land having a lower water table through which the underground waters pass away more rapidly. Few areas devoted to orchards are tiled, but some contain blind ditches or land plowed into ridges. The effect of poor tree growth is more pronounced in places where the soil includes a light-gray layer. Most orchardists practice clean cultivation, and cover crops are grown for plowing under. Manure is applied to the land when available, and sometimes straw is used for mulching. Spraying is regularly practiced, and the general management of the orchards is good. Rhode Island Greening and Baldwin are the main varieties of apples.

Collamer silt loam is a moderately productive soil. The content of organic matter is not high, but the land is managed in such a way as to improve and increase crop yields.

SOILS WITH HEAVY UNDERLYING LAYERS

A number of soils developed in this county are separated from other soils because of the character of the soil material below the surface soil. These soils, in general, contain more clay and silt in proportion to coarser particles and have developed underlying layers of heavier texture than have the other soils of the group.

Some of the outstanding physical characteristics of the soils of this group are the arrangement of soil particles into a compact, firm mass; their toughness and intractability; their resistance to breaking; their slow permeability; and fracturing of the material into cloddy or blocky lumps on drying.

The relief is flat, very broadly undulating, or gently sloping. As a result of their topographic position, these soils receive drainage water from higher lying soils. The soils of this group do not have unusually high water tables, and the soil mass is not saturated for prolonged periods, but lack of drainage is mainly a matter of re-

tardation or slowness in downward percolation, as the structural development of the underlying layers inhibits rapid movement of moisture. During wet seasons, water stands on the surface. The surface layer readily absorbs moisture, but its capacity is limited by its thickness. When the top layer is wet, the heavy underlying layers are comparatively dry, except that part in contact with the surface soil. Some water percolates downward, but this is largely restricted to thin seams along fracture lines or to root channels, and where the slope is gentle some water flows laterally above the heavy layer. The periodic saturation of these soils has created a mottled color in some part of them. Some of the plant nutrients in the soil material have been dissolved and carried in solution to other locations by percolating waters.

These soils warm more slowly after being wet than the well-drained soils, and farming operations in the spring, when the land is usually wet, are delayed. Fall plowing is practiced whenever possible. These soils must be worked under proper moisture conditions, otherwise hard clods are formed.

These soils have a high content of plant nutrients and are considered productive. Under suitable seasonal and moisture conditions, crop yields are good. During dry periods these soils dry and crack, and crops may suffer from lack of moisture. Because of tillage difficulties, a large acreage is given over to pasture for cattle or to the production of hay. General farming, in conjunction with dairying or livestock feeding, is practiced on some of the land.

Lucas silt loam.—Lucas silt loam, to a depth of 6 inches, consists of grayish-brown silt loam which, when dry, is gray on the immediate surface. Below this and extending to a depth of 12 inches, is brownish-yellow or yellow heavy silt loam containing some light-gray mottles. In places the lower part of this layer is silty clay loam. Between depths of 12 and 24 inches, the material is heavy tough blocky dull-brown or medium deep brown clay with thin streakings of light gray. This is underlain, to a depth of 40 inches, by dull yellowish-brown lighter clay or heavy silty clay loam of blocky structure, containing thin laminations of silt loam and, in places, thin gray streaks of limy material. In a few places, the second, or sub-surface, layer is light brown and does not contain pronounced splotchings, and the subsoil tends to have a faint-red tinge or contains lenses of faint reddish-brown material.

This soil is associated with the Dunkirk soils and has similar textural and structural characteristics, but it is duller in color and contains more gray material than does Dunkirk silt loam. Slight variations in the thickness of the several layers, in color, and in texture are developed within short distances.

The soil is mapped in association with Dunkirk silt loam in the western part of the county. The land has been cleared and is farmed in connection with the surrounding soils. Parts of it are planted to orchard fruits which yield moderately well, although some of the trees have been restricted in growth by poor drainage. Drainage is not so good as in the Dunkirk soils, and the trees do not show such favorable growth.

Where their production is attempted, field crops are irregular and uneven in growth. This is caused by minor differences in soil char-

acteristics and drainage. Yields average a little lower than those obtained on Dunkirk silt loam.

Collamer silt loam, heavy phase.—Collamer silt loam, heavy phase, occurs in the lake-plain section of the county. The materials from which it developed were water-borne sediments deposited during the glacial period, and there was little uniformity in their deposition. Subsequent weathering and soil-development processes have not produced a uniform soil condition, and abrupt changes from one condition to another are numerous.

Predominantly the heavy phase of Collamer silt loam, to a depth of 7 or 8 inches, consists of light-brown, grayish-brown, or brownish-gray mellow smooth silt loam containing a moderate quantity of organic matter. This is underlain, to a depth ranging from 14 to 25 inches, by a subsurface layer, which is lighter in color but of similar texture, consisting of light-gray silt loam, stained with rust brown and yellow, or mottled gray and rust-brown silt loam. The proportion of each color is variable. The material is of moderate compaction but is friable. Thin strata of heavier or, in places, lighter material occur within it, but the greater proportion is silt loam. Below this layer the material is dull-brown or medium-deep shades of brownish-gray heavy tough stiff smooth clay streaked with rust brown and gray. When dry, the clay breaks into cloddy fragments, and thin seams of mottled material occur along the fractures. Some of the broken fragments are covered with a thin coating of light reddish-brown material. Interbedded within the clay are irregular lenses or seams of similarly colored smooth floury silt loam. The thickness of this layer ranges from 6 to 15 inches. The substratum extends to considerable depth and is composed of stratified layers of gray, yellowish-gray, and light-brown smooth fine sandy loam, very fine sandy loam, fine sand, or loamy fine sand. Some of the layers are compact, and others are friable. In places, pockets or short thin layers of clay occur.

For the most part, this soil consists of silty upper layers, with some intermingling of clay, underlain at various depths by light-textured or sandy layers, also carrying some heavy material. Most of the soil is free of gravel or stones, and where these do occur, the content is small.

Soil of this phase is associated with the Fulton and Dunkirk soils. In some places it occurs in medium-sized bodies, and in others it forms a complex combination with adjoining soils. Some bodies are scattered in upland basins.

The land is smooth or flat. Surface run-off and internal drainage in general are deficient, and in some places seepage is received from higher land. The underlying sands aid downward percolation. In places the level of the intermittent water table is in the substratum.

Practically all of the land is cleared, and most of it is in cultivation, but its distribution is such that it has only local agricultural importance. On a few farms it is the only soil, on others it is the predominant one, and some fields are composed of it in combination with several other soils. The soil is easily tilled under proper moisture conditions, and some farmers regard it as productive for many crops.

The leading crops are hay, corn, oats, and wheat, and a large acreage is in pasture land. Cabbage, tomatoes, peas, field beans, and fruit are a source of a large part of the farm income. Most of this soil occurs in the fruit belt, where the associated better drained soils are wholly or partly devoted to fruit. A number of orchards have been extended from better drained soils to this soil, and in some sections entire orchards are on it. Some orchards are tiled, drained, or ditched, but individual trees show the effects of spots of land having unfavorable drainage. Apple trees show less susceptibility to inefficient drainage than do peach and cherry trees, and pears and quinces do not suffer adversely from the normal drainage condition. Roots of apple trees penetrate and ramify the several layers down to the lower compact sandy strata, but larger numbers are concentrated in the clay than in the lighter textured material. The dominant apple varieties are Rhode Island Greening and Baldwin. Most fruit growers practice clean cultivation, with a cover crop.

Acre yields of oats range from 25 to 50 bushels, wheat 10 to 20 bushels, corn 50 to 80 bushels, and hay 1 to 2 tons. The crop rotation in general practice includes plowing sod for a cultivated crop, followed by grain, and then seeding to grass. The hay consists of timothy mixed with alsike or red clover. Applications of commercial fertilizer range from 100 to 250 pounds an acre for grain, and for vegetables from 500 to 1,000 pounds. The more popular mixtures are 2-8-10, 5-10-5, and 2-12-4.

Associated with this soil are gravelly areas which, like Collamer silt loam and its phases, are characterized by a great many variations occurring within short distances. Lack of uniformity in thickness, texture, structure, and color of the layers are very striking. Soil development has been very irregular and is influenced or retarded by the character of the soil material and drainage conditions. This soil is definitely different from Collamer silt loam in texture and in the presence of gravelly material which is confined principally to the upper layers and consists of a mixture of pebbles, rounded small gravel, and cobbles, together with flat angular stones a few inches in diameter. The gravel are derived largely from gray and red sandstones and shales, with a less quantity from limestone, granite, and crystalline formations. The layers comprising this gravelly soil may be described as follows:

(1) Medium dark brownish-gray or grayish-brown gravelly loam or silty loam, slightly acid in reaction, ranging from 5 to 9 inches in thickness. (2) Light-gray, light yellowish-gray, or grayish-yellow gravelly loam streaked with rust yellow and brown. This sub-surface layer is distinguished by its leached appearance and the presence of mottles. It is acid in reaction. A light or ash-gray color extends horizontally for a few feet and changes quickly to shades of yellow or drab. This layer ranges from 14 to 16 inches in thickness and is underlain by (3) a layer containing heavier material than that in the layers above. This material is moderately compact but friable heavy silt loam or silty clay loam, with thin interlaminations of very fine sandy loam or light smooth silty loam. The basic colors are dull brown, brownish yellow, or bright brown, streaked with shades of gray, rust yellow, and rust brown. The reaction is neutral

or slightly alkaline. The quantity of gravel is much less than in the upper layers, but pockets of gravel occur in places. This layer ranges from 8 to about 12 inches in thickness. It is underlain by (4) light grayish-brown compact pebbly very fine sandy loam stained with light gray and yellow. This layer is about 6 inches thick, and the material is alkaline in reaction. (5) Compact light-brown material comprising alternating thin strata of silt, very fine sandy loam, and clay, each showing some staining of gray and yellow. This layer ranges from 5 to 8 inches in thickness. (6) Light-brown or grayish-brown compact thinly laminated strata of loamy fine sand and fine sandy loam, extending to a great depth. The few gravel or pebbles in the substratum occur in thin strata 2 or 3 inches thick. The material has an alkaline or calcareous reaction.

These several layers are rather typical in the soil profile, but their alternation with each other, color shades, and degree of compaction or friability are in many places abrupt. Briefly, a generalized profile of this soil includes (1) a surface soil of gravelly material of medium dark color, (2) a gray layer stained yellow, (3) the zone of deepest color and generally heaviest texture, and (4) stratified layers of silt and fine sandy materials.

This gravelly soil occurs in small and moderate-sized bodies scattered over the northern part of the county. The areas are more numerous and of best development in Carlton and Yates Towns. They are associated with other soils of the Collamer series and with the Lucas and Dunkirk soils. On some farms the gravelly soil is dominant.

In drainage this included soil represents an intermediate condition between the Toledo soils and the better drained Dunkirk soils. The soil occupies lake terraces or plains, and it is predominantly smooth or nearly flat. Surface drainage is fairly good, but internal drainage is somewhat deficient, owing to the heavy compact character of some of the lower layers.

Much of the land is cleared and under cultivation. The chief crops are corn, oats, wheat, potatoes, and hay. Hay land and fields reserved for pasture comprise the greater part of the total acreage. The vegetables grown include tomatoes, cabbage, field beans, and peas. Apples, pears, and quinces are the principal orchard fruits, and a few orchards are located entirely on this gravelly soil. Generally the apple trees are planted on transitional areas adjoining better drained soils or where the position of the land favors a lower water table. Some trees show the influence of excess water where planted on land that remains wet for prolonged periods. As a result of good management and the removal of excess water, many trees on this land make fairly good growth and yields. Crop yields and fertilizer applications are comparable to those on typical Collamer silt loam. Where well drained, this soil is of moderate fertility and agricultural value.

Schoharie silt loam.—Schoharie silt loam in cultivated fields is characterized by a surface soil of grayish-brown or medium dark brown friable silt loam mixed with a moderate quantity of organic matter. This material extends approximately to plow depth and is underlain rather abruptly by the subsurface layer. In broad expanses or in slight depressions, the color is dull brown or yellowish

brown, stained with rust brown and yellow, in the upper part of the layer. Below this is light-brown or brown granular silt loam extending to a depth of 10 or 12 inches. The lower 2 or 3 inches of the material has a leached appearance and consists of grayish-yellow or gray silt loam streaked with rust yellow and brown. The third layer consists of light reddish-brown or deep-buff smooth heavy tight clay which has a red tint when moist. The material in this layer breaks along horizontal and vertical cleavage lines into small blocky segments that are hard to crush. At a depth ranging from 25 to 30 inches the material becomes lighter in color and texture as it grades into the substratum of light reddish-brown light clay or friable silty clay loam of variable depth. Along the outer edges of some areas the basal layer includes some gravelly clay loam or loam, and interbedding of heavy silt is common in many places.

The surface soil is somewhat thicker than typical in places where sediments have been received from surrounding soils. Some glacial stone fragments occur in places on the surface near the edges of till soils, but the underlying layers are nearly free of gravel or gritty material.

This soil occurs in small areas scattered across the southern part of the county. In Barre and Clarendon Towns it occupies small depressions in combination with Ontario and Honeoye soils, and in other sections it is intricately mixed with Schoharie silty clay loam, Ontario loam, Wauseon fine sandy loam, and Poygan silt loam.

This soil occupies old lake beds, and the relief in most places is smoothly undulating or has a smooth slight slope. In most places, surface drainage is good, but underdrainage is inadequate. Owing to the heavy subsoil, the horizontal movement of water is more rapid than downward drainage in sloping areas.

Schoharie silt loam is used rather extensively for general farming. It is good farm land, about 95 percent of it is cleared, and probably 85 percent is improved. Where dairying is practiced, a large part of the land is used for hay crops or pasture. The hay crops include alfalfa, timothy, red clover, and alsike clover. Small areas are farmed with other soils, but no special consideration, such as tillage operations and the use of commercial fertilizer, is given to each kind of soil. Corn for fodder and silage, oats, barley, wheat, and white beans are grown, and on many farms, peas, cabbage, and tomatoes are important cash crops. Yields average slightly higher than on Schoharie silty clay loam and somewhat lower than on the Ontario soils.

Schoharie silt loam is outside the main fruit belt, but in a few places apple orchards have been planted on areas that include this soil. The trees respond well and compare favorably, where planted on well-drained land, with those on adjoining soils.

Schoharie silty clay loam.—Schoharie silty clay loam is characterized by a 4- or 5-inch surface soil of grayish-brown or brownish-gray silty clay loam or heavy silt loam, underlain by dull brownish-yellow or dull grayish-yellow silty clay loam or clay containing gray and rust-colored mottles. Below this is light chocolate-brown or pinkish-brown stiff heavy tight clay with streaks of gray along the fracture seams. At a depth ranging from 25 to 35 inches, the material becomes somewhat lighter in texture and less compact. The low-

er part of the substratum consists of interstratified layers of silt in places, and gray lime material in thin seams also occurs.

The surface soil is not so deep as the surface soil of Schoharie silt loam, and the second layer in places is drab heavy silty clay loam extending to a depth ranging from 15 to 18 inches. In some spots the material contains a few mottles, and the heavy clay subsoil occurs at a depth of 8 or 10 inches. Texturally this soil is more uniform than the silt loam. Changes in color are frequent where the land has as slight differences in elevation as 4 or 6 inches.

Schoharie silty clay loam occupies wider and larger areas in many places than the silt loam, and it occurs in scattered bodies through the southern towns, the largest areas being in Barre and Shelby Towns. The relief is gently undulating or flat. Very little stream cutting or erosion has taken place, and a large part of the land lacks adequate natural drainage. Surface drainage is fair, but many wet places are in evidence on the surface during rains. Underdrainage is deficient because of the tight and slowly pervious character of the heavy subsoil material. Some fields have been tile drained, and others have been improved by other forms of artificial drainage; but large areas have only road ditches or a few field ditches for the removal of drainage water, many of which are clogged with vegetation. Some drainage is carried onto the associated Poygan silty clay loam that occupies lower positions.

Between 90 and 95 percent of Schoharie silty clay loam has been cleared and is used for general farming and dairying. If the land is plowed too wet, clods that are hard to pulverize are formed. The soil cracks during the drier parts of the summer, and crops are subject to injury due to lack of soil moisture. Corn, small grains, timothy, alfalfa, clover, and potatoes are grown. The acreage in hay crops and pasture exceeds the combined acreage of all other crops. Some cabbage, beans, and tomatoes are grown as cash crops. The feeding of beef cattle during the winter is followed on some farms. Over a period of years, crop yields are slightly lower than on Schoharie silt loam. Schoharie silty clay loam is well suited to hay crops. Clover does well, and timothy and clover mixed commonly yield from 1½ to 2 or more tons an acre. Alfalfa is grown on a small acreage, and two cuttings a year are made.

Fulton silty clay loam.—One of the important intermediately drained soils is Fulton silty clay loam. It is more extensive than other members of the group and has greater agricultural importance. This soil is a source of greater income and contributes more to the wealth of the county in proportion to its size than the associated members.

The 6- or 8-inch surface soil consists of brownish-gray or gray granular friable light silty clay loam or heavy silt loam. When moist it has a medium dark grayish-brown color. It is underlain by light-gray or grayish-yellow silty clay loam moderately mottled with rust yellow and brown. In places the gray, grayish yellow, and other shades are so blended that it is difficult to determine the basic color, but in most places the lower part of the layer, which rests on the subsoil, is more gray. This layer extends to a depth ranging from about 10 to 16 inches and is underlain by the subsoil of varicolored material, in which one color or combination of colors grades quickly

to another. The colors are shades of gray, light bluish gray, dull brown, and yellow, all containing mottles of rust brown, rust yellow, and gray. The soil material is heavy tough rather impervious intractable clay, which when dry contracts or fractures into small irregular angular masses. The subsoil continues to a depth ranging from 20 to about 30 inches and gradually becomes slightly lighter in texture and less compact. The substratum is gray, grayish-yellow, or brownish-gray clay or silty clay loam, which is more friable than the material above and contains splotches of rust-colored materials and thin horizontal and vertical seams of light-gray material. Lime concretions occur in places. The substratum extends to a depth ranging from 8 to more than 15 feet, and it is more or less interbedded with layers of silt loam and very fine sandy loam.

This soil is comparatively free of stone fragments, but small gravel and flat angular stones are strewn over the surface in places. For the most part, the material in the different layers is smooth and contains little gritty matter. This soil has developed from mixed materials deposited by the action of water, and it includes many variations in texture and depth of material. Small sand spots, a few feet in diameter, are more or less numerous in some areas, and in others, alternate layers of silt and clay make the soil more desirable for cropping than in places where the clay forms a thick deposit. In the network of narrow long swales or depressions, associated with the Dunkirk soils in some localities, there is little uniformity in the upper part of the soil, as such areas have received an irregular covering of silt from adjoining soils. In general, this soil is distinguished by its gray fairly heavy surface soil and its light-colored mottled subsoil resting on dull-drab heavy mottled clay.

The principal developments of Fulton silty clay loam are in an irregular belt extending across the northern part of the county. Small isolated bodies are mapped in a number of places north of the ridge and in a few sections in the southern part. Its occurrence in association with Dunkirk, Collamer, Hilton, and Toledo soils, and also some sandy soils, creates a complicated arrangement in some sections and is responsible for some of the many variations.

Both surface drainage and underdrainage are restricted. The surface material absorbs its limit of rainfall, but excess water is hindered in its downward percolation by the heavy tight underlying clays, and the horizontal movement of drainage waters is slow and retarded by the slight gradient of the land. Some improvement of the drainage is effected by tiling and the construction of roadside and field ditches where connections are made to an outlet through natural channels. The relief is broadly undulating or slightly sloping.

Only about 5 percent or less of the land is maintained as farm wood lots, and the rest is utilized for farming. Comparatively, this land supports a smaller population than is supported on the Dunkirk soils.

A number of cropping combinations are maintained on Fulton silty clay loam in connection with associated soils. Most of this land lies in the more extensive and well-established fruit sections of the county, and some of it is used for orchards. The growing of vegetables for canning is important on some farms, but on many farms general farming and dairying are combined with other ac-

tivities. Hay crops occupy the largest acreage. Some of the fields are used as meadows or pastures for a few years but subsequently are used in a crop rotation. Corn, oats, barley, wheat, white beans, and potatoes are the principal crops, and yields depend largely on drainage conditions. Crop production ranges between the higher yields obtained on Dunkirk silt loam and Hilton silt loam, and the lower yields obtained on the Wauseon, Granby, and Rimer soils. With favorable seasonal conditions, yields are comparable with those obtained on Dunkirk silt loam and Hilton silt loam. Some of the drawbacks to this soil are its low content of organic matter, lateness in warming in spring, slow drainage, and difficulties experienced in cultivation unless the land is handled under a narrow moisture range.

The use of commercial fertilizers is common. A 2-8-10 mixture is used on corn, tomatoes, and cabbage, the acre applications ranging from 500 to 1,000 pounds for the vegetables and about 250 pounds for corn. Superphosphate also is used for corn and potatoes. From 250 to 300 pounds of 4-12-4 or 2-12-4 is applied to wheat, oats, and barley. A 5-10-5 mixture is favored by some farmers for vegetables and field crops.

Apples, pears, and quinces are the main orchard fruits. Pears and quinces occupy small separate blocks ranging from 1 to 5 or more acres, on some farms less than 1 acre. These trees make a fairly uniform growth in the same orchard, but apple trees are variously affected by the soil and drainage conditions. The apple orchards are planted in many places on a combination of this soil with Collamer silt loam, heavy phase, and Dunkirk silt loam. This land naturally is not so well aerated and drained as the associated soils, and trees are affected by these deficiencies. Some orchards are tile drained, and some fruit growers claim that this expense has been repaid within a short time by increased yields and the saving of trees. Many trees of the same age on this land show little uniformity in growth and vigor, especially where drainage is not improved. Some trees have been drowned out. The heavy rainfalls in 1925 and 1926 caused a large number of trees to die or become diseased. Some varieties of apples, such as Rhode Island Greening, respond better on this soil than do Baldwins. Most orchards are well managed. Clean cultivation is followed in most of them, and spraying is usually thorough. Nitrate fertilizers and the available stable manure are applied to the trees.

In some small included spots of silty clay, the soil material is slightly heavier than the typical soil. The 6- or 8-inch surface soil, in these spots, has a range in color like the rest of the silty clay loam, but it contains more clay particles. Below this layer is a thin layer of gray or grayish-yellow silty clay or clay, mottled with rust yellow and rust brown, which grades into pale-yellow or gray tough heavy slowly pervious clay containing faint mottles of gray and yellow. The substratum is dull brownish-gray or dull-gray smooth heavy clay containing some rust-colored mottles, and in places the color is dull reddish brown. In some places lenses of different-textured materials are present.

This included soil occurs in a few widely scattered bodies in both the northern and southern parts of the county, but it is considered

a less desirable soil than typical Fulton silty clay loam, on account of the character of the clay and drainage condition. Surface drainage and underdrainage are greatly retarded by the position of the areas and the structure of the subsoil. The relief is smoothly undulating. The land has been cleared of tree growth. Only a small acreage is used for grains and vegetable crops, and the rest is devoted to grazing or is used as hay land.

Hilton silt loam, heavy-subsoil phase.—The surface layer of Hilton silt loam, heavy-subsoil phase, consists of brownish-gray or medium dark grayish-brown gritty friable silt loam ranging from 5 to 8 inches in thickness. The content of organic matter influences the variable color shades of the surface soil. This layer is underlain by light brownish-gray or gray heavy silt loam or silty loam containing dull-brown and rust-yellow mottles. This material is slightly heavier than that in the surface layer and is lighter in color. It extends to a depth ranging from 11 to about 16 inches. The subsoil consists of dull brownish-gray or brownish-yellow fairly tight gritty heavy clay loam mottled with rust brown and yellow. This material is compact in places, and in others it breaks into angular blocky lumps. It extends to a depth ranging from 25 to 30 inches and is underlain by the substratum of light grayish-brown or brownish-gray gritty silty clay loam irregularly mixed with silt loam and streaked with rust brown, yellow, and gray. Though the greater part of the material in the substratum is unassorted, in some places it contains laminated clay strata, especially where the soil merges with Dunkirk silt loam and Lucas silt loam. Where the soil is associated with the Clarkson soils, the substratum includes small pockets of reddish-brown clay loam or fine sandy loam. Differences in texture, color, and structure occur in the several layers within the same body. A few gravel, cobbles, and flat angular stone fragments occur through the soil. Small patches of silty clay loam are included with the soil in mapping.

Areas of Hilton silt loam, heavy-subsoil phase, are scattered across the northern part of the county. Some occupy ridges within areas of Fulton silty clay loam or positions south of the Fulton-Dunkirk belt. The relief is flat, gently rolling, or undulating.

This soil is associated with Dunkirk silt loam, Fulton silty clay loam, Clarkson loam, Hilton silt loam, and other soils, on a number of farms. Some areas of this soil are large enough to dominate the soils of a farm. Fields covered by the different soils are managed alike. In those sections where this soil is dominant, the acreage in pasture and hay land exceeds that in cultivated crops. Some of the large wood lots include elm, maple, basswood, ash, hickory, poplar, and oak. Representative farms on this soil are used principally for the production of hay (timothy, red clover, and alsike clover), corn, oats, wheat, and barley. Beans, tomatoes, cabbage, and potatoes are cash crops. Generally the hay, corn fodder, and oats are fed on the farm. The production of fruit is not so important as the growing of field crops. Apples and pears are grown, but most of the orchards are established on narrow strips associated with more adequately drained soils. Trees located on soil of this kind do not maintain uniform growth and development, as these are influenced by soil and drainage conditions. The land is of medium value for tree fruits.

SOILS WITH HEAVY BUT SHALLOW SUBSOILS OVER SHALE

Brockport silt loam.—Brockport silt loam in cultivated fields has a 6- or 8-inch surface soil consisting of grayish-brown or brownish-gray heavy gritty silt loam. The surface is pronouncedly gray when the land is dry. During dry periods, the material tends to bake and cracks are formed. Below this layer and extending to a depth ranging from 15 to 25 inches, is dull brownish-yellow or dull-brown silty clay loam containing gray and yellow mottles. This layer is underlain by gray or yellowish-gray heavy tight slowly pervious clay or silty clay, stained with yellow, which contains partly weathered fragments of light-colored calcareous shale and rests at a comparatively slight depth on shale rock.

The soil contains only a small number of stone fragments. It is strongly influenced by material developed, through the process of weathering, from the underlying gray shale rock which, together with glacial debris deposited by ice action, has contributed to the formation of the soil.

This soil occurs in an irregular belt in the eastern part of the county between the Ontario soils on the south and the Hilton and Clarkson soils on the north. Some small bodies are in Shelby Town.

The relief of Brockport silt loam ranges from gently rolling to smooth, and most of the land is favorable to cultivation. Surface drainage ranges from fair to good, but underdrainage is deficient. Downward percolation of water is most effective along fracture seams and cracks in the soil material. The soil is not poorly drained in the sense of becoming completely saturated with water, but the physical character of the underlying layers impedes downward percolation of soil water and keeps the upper part of the soil moist during rainy periods.

With the exception of a few wood lots, all the land is farmed and is used principally for pasture or for hay. Some parts support good orchards, mainly of apples and pears, and small patches bordering other soils are farmed in connection with adjoining soils. A little corn and grain are grown, and yields are low when the growth is stunted during the drier periods of some summers. Tillage operations are difficult, owing to the tightness and heaviness of the soil. Hay produces as much as $1\frac{1}{2}$ tons an acre, wheat from 10 to 18 bushels, oats from 35 to 40 bushels, and corn only moderate yields. Yields of potatoes and beans are about the average for the county. Seasonal conditions, tilth of the land, and management influence the production of crops. The land requires careful handling at times when moisture conditions are favorable. Trees planted in depressions or where seepage occurs are stunted in growth or have died because of unfavorable conditions of soil and drainage. Some farmers engage in dairying as an adjunct to the established systems of farming on this soil.

Included with this soil in mapping is a small acreage of land, limited to several small bodies south of Medina, in which the texture of the surface soil is lighter than elsewhere. The surface layer is brown or grayish-brown silty loam, loam, or fine sandy loam. The subsurface layer is heavy yellowish-gray gritty tight silty clay loam stained with rust yellow, but the material is more friable than the corresponding layer in the typical soil. The lower part of the in-

cluded soil is composed of material similar to that in the typical soil. Areas of soil having a silty clay loam texture have a limited development southwest of Fancher and in the southwestern part of the county. The soil in these areas is characterized by the heavy tight character of the underlying layers and the heavy texture of the surface soil. Cracks are formed from the surface down into the subsoil when the material dries.

Some included areas have stony fragments and gravel scattered over the surface and through the upper soil layers. Calcareous shale and sandstone predominate over red shale, red sandstone, and granite. Underlying beds of gray shale are reached at a depth ranging from 5 to 10 feet. In some places, the surface of plowed fields presents a spotted appearance of light- and dark-colored materials. The lower part of the soil is calcareous. Most of the gravelly areas are in Murray and Clarendon Towns, in association with Ontario soils, the imperfectly drained phase of Brockport silt loam, and typical Brockport silt loam. In places, the soil material is intricately mixed and forms an intergrade between areas to the north which are influenced by red shale and red sandstone and those to the south that are modified by limerock. The subsoil of this included soil is much heavier in texture than the subsoils of the soils in the bordering belts of land. The gravelly areas are prevailingly undulating, with some inclusions of small knolls and narrow short ridges. They lie at a higher elevation than Clarkson loam and Hilton loam and are somewhat lower than the Ontario soils. Where the relief is uneven, fair to good surface drainage is established, but in level areas the run-off is slower. Owing to the slowly pervious character of the clayey subsoil, downward percolation is slightly impeded. The comparative effectiveness of aeration and drainage is better than in the typical soil and in the imperfectly drained phase, which are derived from similar materials.

Areas of this gravelly soil are used most extensively for general and dairy farming, and some of the land supports wood lots of elm, maple, ash, and oaks. Probably 70 percent of the land is in hay or pasture fields. The main field crops are corn, oats, and wheat, and barley, white beans, cabbage, and tomatoes are included in the rotations. Alfalfa has been established in a number of fields. Timothy is the main grass crop, but mixed timothy and red clover are grown also. This is regarded as a productive soil when seasonal conditions are favorable for plant growth. It is difficult to handle unless precautions are taken to cultivate it under correct moisture ranges. The land is fall plowed if weather conditions are favorable. Stable manure and commercial fertilizer are used for the different crops, and yields range from medium to good. A number of commercial apple orchards are established on this land, and some peaches are grown. The trees maintain a good growth in most places.

Lockport silty clay loam.—Lockport silty clay loam is a shallow soil composed of mixed materials which were deposited and reworked by glacial action during the time old Lake Iroquois receded from its southern shore line to the present level of Lake Ontario.

The surface soil consists of a friable mixture of grayish-brown, brown, or light-brown gritty silt loam or silty clay loam to a depth ranging from 6 to 15 inches. In forested areas the immediate surface material is darker, caused by incorporation of organic matter. The

color of the material immediately below the surface layer is somewhat variable. It is lighter and includes shades of brown, yellow, and buff splotched with rust color and light gray, the proportion of staining varying according to local drainage conditions. This layer is thin, ranging from about 2 to 5 inches in thickness, and is transitional to the layer below, upon which it rests abruptly. The third layer consists of deep reddish-brown, pinkish-red, or light-red stiff smooth heavy clay or silty clay loam which gives way, at a depth ranging from 20 to 30 inches, to red more friable fine shaly clay, residual from the underlying red shale, at a depth ranging from about 3 to 5 feet. Scattered over the surface and through the upper part of the soil is an irregular assortment of rounded, flat, and angular stony fragments and medium-sized boulders, locally called hard-heads. A large proportion of the stones are from local red sandstone and shale formations, but fragments from other localities are included.

This soil is developed chiefly in several large bodies north of the ridge road, the most extensive occurring in the towns of Murray and Kendall. Several medium-sized areas are in parts of Ridgeway and Yates Towns.

The land has fairly smooth or undulating relief. Very few natural drainage channels or draws have developed within areas of this soil, and connections to drainage basins are limited, which features, together with the plainlike terrain and very slowly pervious substratum, cause accumulated water to pass away slowly. Heavy rains saturate the surface soil and form a water table on top of the underlying red clay which may be barely moist.

Very little agricultural use is made of this land. A larger proportionate acreage remains forested than of any other soil in the county. The tree growth is dominantly elm but includes ash, hickory, moisture-loving oaks, maple, poplar, basswood, and beech. A large proportion of the cleared land is idle, abandoned, or pasture land, but the pasture value of the native grasses is small because of their sparse growth. Many pastures include some Kentucky bluegrass, creeping bent, redtop, Canada bluegrass, and many weeds, such as devil's-paintbrush, goldenrod, aster, dandelion, quackgrass, Canada thistle, teasel, and wild carrot. In some abandoned or intermittently used pastures thorn apple has encroached. Practically no attempt is made to improve or reseed the pastures. Some farmers use or rent their land for sheep pasture.

The general aspect of farms on this soil is very different from that on other soils, as many farmhouses and barns are abandoned or in a tumble-down condition, fences are broken or missing, in fact, most of the farms show a general lack of prosperity.

Some areas of the deeper soils are utilized for general crops or for the growing of vegetables for canning. Crop yields are only fair. Acre yields of wheat range from about 10 to 20 bushels, although some farmers state that formerly they obtained as high as 60 bushels; corn 20 to 35 bushels; oats 25 to 40 bushels; beans 8 to 10 bushels; and hay $\frac{3}{4}$ to 1 ton. Alfalfa has been successfully established on a few acres. A few small orchards of apples, pears, and quinces are scattered over this soil, but their general run-down appearance indicates unsuccessful attempts to compete with the fruit

growers on better fruit lands. The orchards receive little care and seldom are sprayed sufficiently or pruned.

Much money and continued effort are essential, in order to put this soil into condition to compete with more productive soils, on which good yields are obtained at less cost. Under prevailing agricultural conditions many farming enterprises have failed on Lockport silty clay loam, consequently, it would seem more profitable to use this soil for timber, hay, or grazing land.

The textural variations from the typical silty clay loam are related to the depth of the soil over the underlying red clay. The areas of deeper soil trend to silt loams or heavy silt loams, and their most common occurrence is as narrow low ridges, knolls, or barlike formations. The texture of the surface layer is heaviest where the underlying clay is within 10 inches of the surface. In some depressions the included soil is clay. These variations have some agricultural significance, but they are too intricately associated with each other to be separated on the soil map. The surface layers are slightly acid, and the subsoil also is acid, but the lower part contains some lime material in places. Sweetclover maintains a growth along roadsides where the sweet lower layers of the soil are exposed.

Narrow winding depressions, from 6 to 20 inches below the surrounding land level and ranging from 10 to 20 feet in width, in which the surface soil is dark brown or dark brownish gray and is underlain by red clay, are included with this soil as mapped. These depressions are more or less disconnected and probably represent former drainageways. Many of them are covered by a growth of coarse grasses, reeds, and rushes.

In some places soil mapped with Lockport silty clay loam has a 6- or 8-inch layer of medium dark grayish-brown or brownish-gray gravelly loam or gravelly silt loam, underlain by a 2- or 4-inch layer of light-gray or yellowish-gray silt loam or loam, mottled with yellow, which grades into dull-brown or yellowish-brown silt loam splotched with gray and yellow. This material merges with light reddish-brown, yellow, or brown heavy silt loam or silty clay loam, mottled with rust yellow and gray, which rests on red shale rock at a depth ranging from about 20 to 40 inches. In places where this soil merges with typical Lockport silty clay loam, it includes narrow bands of the typical soil. In some of the transitional areas the soil material ranges from only 10 to 15 inches in thickness. This included soil occurs only in a small section in the northwestern part of the county, in the vicinity of County Line and Millers. The land is faintly undulating or flat, but in places short narrow ridges are a few feet above the general level. Nearly all this included soil has been cleared and is utilized for pasture, fruit, some general farm crops, and vegetables, as tomatoes, peas, and cabbage. Crop yields are variable and generally low. Because of soil and drainage differences, considerable differences in crop growth result over a field. The parts of orchards that have been extended to this soil from adjoining land lack uniformity of growth. Trees are missing in places, others have a straggly uneven growth, and even the trees on the deeper soil, though somewhat larger, do not show vigorous growth. The potential agricultural value of this soil is comparatively small.

SANDY SOILS

The sandy soils of this group, with their open, porous structure, normally allow rapid passage of rainfall through them. They are underlain by till or clay substrata or occupy positions that are influenced by a fairly high water table during some season of the year; but the water table is not permanent, and its height fluctuates with the intensity and length of the rainy season. The level of the water table in the sandy soils is confined to the lower part of the soil mass, and in this position the saturated condition of the soil material is not detrimental to the normal growth of crops and plant roots. On the contrary, the moisture content of this part of the soil during dry months may be a controlling factor in satisfactory crop growth and result in better growth than on drier sandy areas. In the spring, however, these soils are likely to remain cool for a longer time than other sandy soils, such as Petoskey fine sandy loam and Arkport fine sandy loam.

The sandy soils, as their name implies, are characterized by their sandy texture. The surface layers are well oxidized, well aerated, have accumulated very little organic matter, and are yellow or light brownish yellow. Their subsoils and substrata, however, show a variety of colors and shades, as a result of the leaching action of soil water. Drainage is moderately well established. The natural fertility is lower than that of other soils of the group. The producing power of the sandy soils necessarily is maintained or increased by proper crop rotations and correct use of fertilizers.

Berrien loamy fine sand.—The most extensive sandy soil is Berrien loamy fine sand, and its location, ease of handling, and utilization render it of some agricultural importance.

The 6- to 9-inch surface layer is light-brown, grayish-brown, or yellowish-brown loamy fine sand containing very little organic matter. It grades into yellow or brownish-yellow loose fine sand which extends downward to a depth ranging from 14 to 20 inches and merges with pale-yellow or grayish-yellow fine sand or slightly loamy fine sand, mottled with gray, rust brown, and rust yellow, and containing small aggregates of slightly coherent loamy fine sand. The material in this layer is faintly compact. At a greater depth the material consists of moderately compact light brownish-gray loamy fine sand slightly stained with rust brown, yellow, and gray. The lower part of the soil mass is somewhat stratified or cross-bedded with various grades of sand or very fine sandy loam.

This soil is moderately acid to a depth ranging from 25 to 35 inches, below which it contains some form of lime. Most of the areas are free of stones and gravel, which are nowhere abundant.

The relief ranges from flat and slightly sloping to wavy and knolly, with a difference in elevation ranging from 3 to 5 feet or more. The soil material extends to a depth ranging from 8 to 15 feet, where an underlying formation is reached, which is sufficiently close structured to hold up a water table. The top of the water table does not everywhere affect the soil in the same way because of the different surface levels, consequently the soil is moist at different levels below the surface, and the mottled condition produced by saturation occurs at different depths. This condition has a direct

bearing on crop growth, the amount of soil moisture either retarding or favoring crop growth during the growing season.

Berrien loamy fine sand is associated with a number of other soils, the most important of which are Fulton silty clay loam, Rimer fine sandy loam, Lockport silty clay loam, Granby loamy fine sand, and Arkport fine sandy loam, smooth phase. The greatest development of this soil is in a broken belt extending across the county north of the ridge road. The individual bodies are small, many of them 5 acres or less in extent. In some places they are widely scattered, and in others they are separated by narrow swales and depressions. In combination with the adjoining soils, many narrow transitional conditions prevail and cause a change from one kind of soil to another within a short distance, but in the main belt this soil dominates other soil combinations.

At least 90 percent of the land is cleared. The greater number of cleared areas, particularly those adjoining well-developed land, are used for a combination of general cropping, orcharding, and vegetable growing. Most of the small areas that occur within areas of Lockport silty clay loam are idle or are used as grazing land. The trees in the areas maintained for wood lots include elm, maple, basswood, hickory, poplar, and some oaks.

The more important cultivated crops are corn, wheat, oats, beans, peas, cabbage, and tomatoes, with an occasional crop of buckwheat, barley, and rye. Timothy and clover are the hay crops, but clover does not do especially well, and the stand of timothy is sparse in many places. Most of the pastures are weedy, and the growth of edible grasses is not heavy. Only moderate crop yields are obtained, and they are not uniform over a field. Corn yields range from 30 to 50 bushels an acre, wheat 6 to 10 bushels, oats 15 to 30 bushels, and hay usually less than 1 ton.

Rotations of the general farm crops are modified to include some vegetables grown for canning. Melons, cabbage, cucumbers, and strawberries are grown on a small acreage. The use of commercial fertilizer is general on this soil, and the applications differ with the crop and rotation. The mixtures in common use are 2-8-10, 5-10-5, 2-12-4, and 4-16-4. Some farmers make heavier applications of stable manure on this soil than on the heavier soils.

Much of the land is used for fruit growing, and many commercial orchards are located on this soil and associated soils. The acreage devoted to apples is larger than that for other fruits; peaches rank second; and cherries, plums, bush fruits, grapes, and strawberries are grown. Peach and cherry trees grow and yield better on this than on many other intermediately drained sandy soils, but not so well as on Arkport fine sandy loam, smooth phase, as it is a colder soil than the Arkport, and the blossoming period is slightly later in some localities. Some differences in the growth and appearance of the trees occur over this soil. The trees occupying the higher places are more vigorous and larger, whereas those in other places are stunted or have died. The best results over a period of years are obtained on the more adequately drained parts of the land. Fruit growing on this soil has been fairly successful, and some orchards show good management and care.

Several variations are mapped with Berrien loamy fine sand, which have a tendency to have better drainage. One of these occupies a small area near Morton, where the soil occupies the lower slopes. This condition is due to a greater depth to clay, and in places the lower part of the subsoil consists of sandy material interbedded with thin strata of silty and clayey material. This land is used principally for peach and apple orchards.

In places soils of coarser sandy materials having similar drainage conditions are mapped with Berrien loamy fine sand, such bodies consisting of Berrien loamy sand. The surface soil is grayish-brown or light-brown loamy sand about 8 inches thick, below which the material grades into light yellowish-brown or brownish-yellow loose loamy sand having no compaction. Between depths of about 15 and 25 inches is brownish-yellow or grayish-yellow sand or loamy sand, splotched with rust-yellow, rust-brown, and gray material, and slightly compact in place. In places where it adjoins Hilton loam and Clarkson loam, the soil contains some gravel, and several areas in other places have a moderate quantity of small round gravel and pebbles over the surface and through the soil. These loamy sand areas are comparatively inextensive and occur in scattered localities within the Berrien soil belt. In general, drainage is somewhat better than in the typical loamy fine sand, and the intensity of the mottling in the lower part of the soil is not so strong as in the finer textured soil. Some of the soil material in the higher lying areas is more porous and incoherent and tends to be drier. Most of the loamy sand areas are improved and are utilized under the farm practices prevailing in the fruit belt. Crop yields average slightly lower than on Berrien loamy fine sand.

Berrien loamy fine sand, shallow phase.—Berrien loamy fine sand, shallow phase, is essentially like the typical soil in its upper part. The only significant difference between the typical soil and the more shallow soil is that the sandy part of the soil, at a depth ranging from about 30 to 40 inches, rests on unassorted or mixed materials of moderately heavy texture instead of continuing downward as stratified sandy layers. The underlying formation consists of glacial till or reddish lacustrine clays. Briefly, soil of this phase represents areas where there is a shallow deposit of loamy fine sand over till or lacustrine clays.

This shallow soil is free of stony fragments, except in a few unimportant spots where a small quantity of cobbles and gravel are mixed with the sand. All the areas of this soil are small and widely scattered. They are farmed like typical Berrien loamy fine sand and produce essentially the same yields.

Mapped areas included with Berrien loamy fine sand, shallow phase, consist of materials that have developed textural layers, structure, and color variations, such as characterize the typical soil. The soil material differs only in that it is shallower and rests abruptly on red shale rock or red clay residual from the shale, at a depth of less than 4 feet. Only a few scattered bodies of this soil are mapped in Yates Town. The individual areas are small, and their total acreage contributes very little to the agricultural production of the county. Some of the small ridges within areas of Lockport silty clay loam are either idle or are used as pasture, and parts of other areas are farmed with

associated soils or planted to orchards. Crop yields are approximately the same as those obtained on the deep soil.

Berrien very fine sandy loam.—The surface layer of Berrien very fine sandy loam is light-brown or grayish-brown mellow very fine sandy loam containing a small quantity of organic matter. It grades, at a depth of about 6 or 8 inches, into brownish-yellow or light-yellow loamy very fine sand or very fine sandy loam. At a depth ranging from 15 to 22 inches the material in this layer passes into dull-yellow, yellowish-gray, or brownish-yellow very fine sandy loam or fine sandy loam, containing rust-colored and light-gray mottles. Typically the soil contains very little fine gravel or stones. The surface layers are slightly acid, but this condition does not prevail at the greater depths. In depressions or swales, the color of the surface soil is somewhat darker and the mottling is closer to the surface.

Berrien very fine sandy loam occurs in small areas, covers a small total area, and is distributed in widely separated sections of the county. It occurs mainly in association with Wauseon fine sandy loam, Wolcottsburg silt loam, Collamer silt loam, poorly drained phase, Poygan silt loam, and Petoskey fine sandy loam. This soil occupies the higher sandy islands within areas of Wolcottsburg silt loam and Wauseon fine sandy loam. Methods of cultivation and utilization of the land are influenced by the farming systems prevailing on the associated soils.

The sandy character of the surface layers allows free passage of rain water, but underdrainage is not so rapid because of the presence of a water table at some depth below. Most of the soil occurring in association with Wolcottsburg silt loam and Wauseon fine sandy loam is forested or in pasture, but other areas have been improved and are cultivated with the associated soils. In general, the fertility of this soil is slightly higher than that of Berrien loamy fine sand, and yields average a little better.

Areas of loam texture are included with Berrien very fine sandy loam as mapped. This is not a soil consisting of definite uniform layers but rather an irregular assortment of light-textured bedded materials that, in places, include pockets or large lenses of unassorted materials. The surface layer is a combination of grayish-brown or brownish-gray silt loam, fine sandy loam, or very fine sandy loam, blending from one to another within a few feet. The subsurface layer, at a depth of about 6 or 8 inches, consists of brownish-yellow or yellow materials similar in texture to the surface soil. This grades, at a depth ranging from 14 to 18 inches, into lighter colored bedded layers of silt, very fine sandy loam, and fine sandy loam, stained yellow and gray and containing irregular lenses of brownish-yellow and yellow silty clay loam, loamy sand, or silt loam, which are stained gray along fracture lines. The soil rests on limerock at a depth ranging from 5 to more than 8 feet. Gravel, pebbles, and small boulders occur in areas of this soil adjoining areas of soils containing such material. This loam soil is confined to several small bodies near Shelby along Oak Orchard Creek, and part of the village of Shelby is situated on it. The relief is smoothly undulating. Surface drainage is adequate, but underdrainage is slightly impeded by the underlying rock formation.

The main use of this included soil is for general farming and fruit growing. Fruit trees growing on it are extensions of orchards from adjoining soils. In most places the land is farmed with the more productive soils surrounding it. This soil is easy to cultivate, but yields are variable on account of the many variations within it and the influence of drainage. In fertility it corresponds to Berrien very fine sandy loam.

Rimer fine sandy loam.—Rimer fine sandy loam is characterized by sandy materials similar to those in Berrien loamy fine sand, but it rests, at a depth of less than 40 inches, on clay. The surface soil, to a depth of 7 inches, consists of brown, light grayish-brown, or medium dark yellowish-brown loamy fine sand or fine sandy loam, having a loamy feel produced by the content of organic matter. Below a depth of 7 inches and extending to a depth of 20 inches, the material consists of light brownish-yellow or yellow loose fine sand or loamy fine sand, faintly or strongly stained with light gray in the lower part. Parts of this layer contain small lumps of cemented material stained with gray. Between depths of 20 and 30 inches, is gray or grayish-yellow compact but friable loamy fine sand containing mottles of orange, rust yellow, rust brown, and light gray. Some of the rust-colored aggregates have been cemented into a moderately firm mass by iron compounds contained in the soil. This material is underlain, to a depth of more than 50 inches, by dull-brown or brownish-gray heavy smooth tight calcareous clay with splotchings of light gray, rust yellow, and rust brown.

The depth of the sandy material ranges from about 8 to 40 inches. Where this soil is associated with Lockport silty clay loam, the underlying clay is somewhat red. In swales or depressions, the surface soil is slightly darker and the material is more mottled than in other places.

The relief is characterized by a succession of alternating small rises and slight depressions.

The soil occurs in scattered comparatively small areas, mainly throughout the northern part of the county, the larger areas occurring in the northwestern part. It is associated with Toledo silty clay loam, Lockport silty clay loam, Berrien loamy fine sand, Wauseon fine sandy loam, Fulton silty clay loam, Granby loamy fine sand, and Arkport fine sandy loam, smooth phase. Drainage is affected by the depth to clay or the location of the soil along streams. The upper part of the soil is porous, and rainfall passes quickly to the clay layer, but there the downward movement of ground water is impeded and percolation may become lateral. The better drained areas are along stream valleys, and in some areas drainage has been improved by tiles or ditches.

Rimer fine sandy loam is used for all crops common to the section. Approximately 95 percent of the land is cleared, and about 90 percent of the cleared land is improved for cropping. Corn for fodder and silage, oats, wheat, potatoes, and hay are the main field crops, and many truck crops, such as cabbage, tomatoes, peas, beans, carrots, and sweet corn, are grown. Heavy applications of commercial fertilizers, ranging from 800 to 1,000 pounds an acre, are made on truck crops. The more common fertilizer mixtures are 2-8-10, 4-16-4, 4-12-4, 2-12-4, and 5-10-5.

As on all the sandy soils of this group, the growth of crops over the same field is uneven, as a result of differences in drainage, soil characteristics, and farm management. Crop yields average higher than on Wauseon fine sandy loam, Granby loamy fine sand, Berrien loamy fine sand, Lockport silty clay loam, and Toledo silt loam, and lower than on Arkport fine sandy loam, smooth phase, but seasonal factors change the comparative yields on these soils. The natural fertility approximates that of the Berrien soils.

The land is considered suitable for fruit growing, and a number of bodies in the Lyndonville fruit belt are planted to orchards. Apples, cherries, peaches, plums, and pears are grown, with moderate yields, but this land is not considered so suitable for cherries and peaches as are Arkport fine sandy loam, smooth phase, and Berrien loamy fine sand. Apple trees do best on the better drained areas. Some trees are affected by the high water table over the clay. In general, Rimer fine sandy loam is less desirable for fruit trees demanding good aeration and drainage than are Berrien loamy fine sand and Arkport fine sandy loam, smooth phase.

Small scattered areas of very fine sandy loam texture are included with this soil as mapped, principally in the southwestern part of the county. These areas occupy small smooth or uneven ridges lying at elevations slightly higher than the surrounding soils. Drainage of these areas is fair. The finer texture of the material gives the surface soil a higher capacity for retaining moisture than Rimer fine sandy loam, but the compact subsoil hinders downward circulation of ground water, and some of the water moves over the top of the clay. Most areas of this soil, because of their location, remain idle or are used as pasture land in association with surrounding soils, although a few bodies or parts of individual areas are farmed to field crops. Parts of apple orchards extend from other soils onto this soil, but no orchards are entirely on it. Systems of farming prevalent on adjoining soils are followed, and crop yields are slightly higher than those obtained on Rimer fine sandy loam.

Poorly Drained Soils

About 25 percent of the soils mapped in Orleans County occur in topographic positions influenced by and subject to waterlogging and seepage from adjoining higher soils for prolonged periods during the year. They occupy swales, broad smooth basins, depressions, and gentle slopes, from which drainage waters move very slowly. The surface of these soils, during spring thaws and following heavy rainstorms, remain covered for some time with shallow water, and the gradient of the land, underlying geologic strata, structure of the soil material, position, and size of the drainage area affect the time required for the water to pass on to natural outlets and valley streams. Catchment basins having no natural outlets occur in places, and in these the soil may remain moist or saturated most of the year.

Weathering agencies that normally operate on soil material are greatly restricted in their activities when the land is wet; oxidation and aeration of the soil material are incomplete; and the more readily soluble mineral matter is leached out and is carried downward by the water and precipitated out in various combinations at other

points. Decaying vegetable matter from leaves, twigs, grasses, roots, and other debris has become incorporated with the surface soil to a much greater extent than in other soils of the county, and, as a consequence, soils of this group have comparatively higher fertility than the well-drained soils.

Regardless of texture, these soils have a darker surface soil than other soils. The surface soil is underlain by a lighter or somewhat gray material that is more or less varicolored. This layer merges at various depths into the partly weathered or unaltered substratum. These soils have an alkaline or calcareous reaction much closer to the surface than do the better drained soils, and the surface soil in most places is sweet or only very slightly acid.

These soils are composed of a mixture of materials, sands, silts, and clays—the proportion of each of which has been influenced to a great extent by the method of accumulation. Some of the soils are formed from different materials that had accumulated into a heterogeneous mass by the action of ice during the glacial epoch; others are formed from sediments assorted by water from melting ice or deposited by the subsequent action of water into a series of bedded layers; and in some places the materials have been influenced by a combination of these agencies.

Some of the underlying materials are compact. The particles are bound together to form a firm coherent mass, but when disturbed they are friable. Others, particularly the clay material, which is tight, tough, and resistant to fracture, have developed into such a tight mass as to be nearly impervious to drainage water. Water effects an entrance into the clay very slowly along very thin seams.

The poorly drained soils have been improved very little for crop production, but the sandy members in some areas offer less difficulty when farmed than do the heavy-textured soils, although their utilization has been restricted by poor drainage. When the land is cultivated, crop returns are uncertain, and often failure results. The labor and time involved in the improvement of these soils are expensive, and farmers have confined most of their operations to the better drained soils. The poorly drained soils are predominantly grass, forest, or pasture land. Throughout the section of their occurrence they are in many places associated with better drained soils in the same field, and may be placed in the crop rotation followed on the adjoining land, or a narrow strip on their outer border may be cropped. These soils are considered very undesirable for apples, peaches, and cherries, and few trees are planted on them.

Soils of two textural classes occur within this group. Those of one class include a number of soils with pronounced sandy characteristics, having friable porous upper soil layers underlain by moderately compact sandy material which hinders free downward circulation of ground water, and as a result the upper part of the soil remains moist for some time. The other class includes soils derived predominantly from silts and clays.

SANDY SOILS HAVING FAIRLY COMPACT SUBSOILS AND SANDY SUBSTRATA

Granby loamy fine sand.—The 8- or 10-inch surface layer of Granby loamy fine sand is dark brownish-gray or very dark gray loamy fine sand or fine sandy loam. This grades into yellowish-gray,

grayish-yellow, and gray slightly compact loamy fine sand or fine sand, mottled with light gray and rust yellow and containing small irregular aggregates of coherent fine sandy loam. In places where subject to a higher water table, the material of this layer is light gray. At a depth ranging from 18 to 25 inches, are light brownish-gray, yellowish-gray, and gray stratified layers of fine sand and sand, containing some staining of gray and yellow. Lenses of deeper colored fine sandy loam are part of the material. The soil is sweet or only slightly acid in the surface layer, and below it has an alkaline reaction.

Where this soil grades into adjoining better drained sandy soils, the surface soil is not so dark as typical as it contains less organic matter. The lower part is not uniformly compact, and the material is friable in places. The sandy particles are not consistently fine but include medium-textured material, especially in the long narrow basins or depressions bordering the ridge road, where the texture has been influenced by nearby areas of Alton coarse sandy loam. Very little gravel is present in this included soil, but in places thin strata, 1 or 2 inches thick, are interbedded in the substratum.

Granby loamy fine sand occurs throughout the sandy belt of soils in the northern part of the county, where it is associated with the Rimer, Berrien, and other low-lying soils. The total area is small, and the individual bodies are rather widely separated. The soil occupies nearly flat and smoothly sloping positions, lower than the surrounding soils. The run-off is slow because of the low-lying position of the soil which is subject to a water table that at times is close to the surface. Its poorly drained condition renders this soil undesirable for agriculture.

This land is mainly in pasture or is kept in wood lots, in which the dominant trees are elm and soft maple, with some ash, birch, beech, oak, poplar, hickory, alder, and some other trees. Marginal narrow strips of some areas adjoining improved better drained lands are used for general or truck crops, and probably from 3 to 5 percent of the land may be classed as sufficiently improved for crop production. Drained areas are used for such truck crops as cucumbers, carrots, cabbage, or tomatoes. Some orchard trees have been planted on the outer borders of the soil, but some of the trees are stunted in growth, in comparison to those on better land, and others have died or are doing poorly. Land of this character should not be used for fruit trees.

This soil is only moderately fertile, and, because of poor drainage and cost of improvement, it has low agricultural value. Under present economic conditions it does not produce sufficiently well to place it in competition with better drained, more productive soils. Its chief value is for grazing, hay, and forestry.

Included with this soil in mapping are areas which have a 7- to 9-inch surface soil of dark-gray or dark brownish-gray very fine sandy loam. The dark color is caused by organic matter, and in places the content is sufficient to make the material somewhat mucky. The subsoil is yellowish-gray, brownish-yellow, and gray very fine sandy loam mottled with rust yellow and light gray. The upper part is whitish gray in places. The substratum is compact but friable light brownish-gray, gray, or dull brownish-yellow fine sand, very

fine sand, or loamy fine sand, with rust-colored stainings. The lower layers of this very fine sandy loam soil generally are moist and often are saturated. After heavy rains the water table is close to the surface.

The included soil occurs in small bodies over the southwestern part of the county and in some sections of Ridgeway Town. It occupies swales and depressions between ridges or flats where conditions are not favorable for the rapid removal of water. A few areas have been drained by open ditches and are used for the growing of corn, vegetables, or hay, but the chief value of this included soil is for pasture or forestry. The pasture land supports a cover of native grasses, sedges, and weeds, and no methods are used for improving the quality of the grass cover.

Colwood fine sandy loam.—The surface soil of Colwood fine sandy loam is dark-gray or dark brownish-gray fine sandy loam, and it includes spots of loamy fine sand or light loam. It averages about 8 inches in thickness, but in places it ranges from 12 to 15 inches. Narrow strips, which are somewhat lighter in color, occur along the outer edges of the areas. The upper part of the subsoil is a combination of light-gray, grayish-yellow, or light dull-yellow loamy fine sand or fine sandy loam, containing rust-colored and light-gray mottles. The material is moderately coherent. The lower part of the subsoil is a continuation of the same irregularities in color and soil texture, but, in addition, it contains some interbeddings, lenses, or pockets of very fine sandy clay loam, silt, or silty clay loam. The color of the heavier material includes shades of yellow and gray, with rust-colored splotches. The substratum, at a depth ranging from 25 to 30 inches, is in most places light grayish-brown very compact very fine sandy loam or fine sandy loam, stained light gray, yellow, and rust brown. In a few places small rounded gravel are mixed through the soil and form thin layers in the subsoil.

This soil occurs in association with Dunkirk gravelly loam, Berrien loamy fine sand, Granby loamy fine sand, Collamer silt loam, heavy phase, Fulton silty clay loam, Rimer fine sandy loam, and Wauseon fine sandy loam, and includes spots or developments similar to those soils.

The layer above the compact material is moist during a large part of the year, and at times the water table lies within a short distance of the surface. This soil does not occur in large belts, and the individual areas are distributed, together with the above-mentioned soils, in several parts of the county. The soil occupies lowlands, depressions, and flats, that serve as basins for drainage from larger drainage areas. Ditches have been constructed on some farms to carry away excess water and improve the land for farming operations.

Colwood fine sandy loam is best suited for hay and grazing land, and about 85 percent is so used. Wood lots cover a part of the remainder. The acreage in cultivation is farmed with adjoining soils and is used for the production of corn, hay, small grains, tomatoes, and cabbage. The agricultural value of the land compares favorably with that of Wauseon fine sandy loam and Rimer fine sandy loam.

A variation mapped with Colwood fine sandy loam has a dark-gray or dark brownish-gray fine sandy loam surface soil. This material grades into light-gray loamy fine sand which generally is moist. At

a depth ranging from 20 to 30 inches is pinkish-brown or pale reddish-brown compact fine sandy loam. This variation is of very small extent and is of only local importance, as the few small bodies are widely distributed. Most of the included land is used for hay crops or is maintained in pasture.

Colwood silt loam.—The outstanding features of Colwood silt loam are a dark-colored surface soil of medium-textured material grading into light-gray sandy material which, in turn, rests on light-brown or pinkish-brown fine-textured sandy material.

To a depth of 10 inches, Colwood silt loam consists of very dark gray or dark brownish-gray silt loam or silty loam, with a granular structure and a moderately high content of organic matter. Between depths of 10 and 16 inches, the material is gray or light-gray silt loam with pockets or lenses of silty clay loam stained rust yellow. This layer is irregular in development but as a rule is heavier textured than the surface soil. Below a depth of 16 inches and extending to a depth of 25 inches, is light-gray or whitish-gray very fine sandy loam containing lenses of silt loam. This is underlain by light reddish-brown, pinkish-brown, or salmon-colored fine sandy loam or very fine sandy loam, which is moderately compact in place and extends to a depth of more than 50 inches. It shows some stratification and contains thin layers of pebbles in places. The content of lime is sufficient to prevent an acid reaction.

This soil occupies basins or depressions, scattered widely across the northern part of the county. The relief is smooth or gently sloping. The soil is subject to prolonged wetting during some seasons of the year, because, owing to its position, the lateral flow, as well as downward percolation, of water is restricted.

Drainage has been improved in some places, and the land is used for the production of a variety of crops. This is a moderately rich soil, and, where drainage has been improved, it gives satisfactory crop returns. Some areas, however, are so situated that drainage by ditches or tiles is prohibited by the expense.

Parts of some areas are used for the production of corn, small grains, beans, alfalfa, and vegetables. High yields are obtained on the more favorably located areas with adequate drainage. This land is not suitable for apple, peach, or cherry trees. The greater proportion is in pasture or hay land. Wood lots include mainly elm and soft maple.

Included areas mapped with Colwood silt loam have a 6- to 12-inch surface soil of dark-gray or dark grayish-brown mellow smooth light silt loam, silty loam, or very fine sandy loam. This grades into mixed gray, light-gray, grayish-yellow, or dull brownish-yellow fine sandy loam or very fine sandy loam, mottled with yellow, which merges, at a depth ranging from 15 to 18 inches, into brown, buff, or light reddish-brown silt loam or heavy silt loam, containing lenses of gray and yellow very fine sandy loam. This layer ranges from 2 to 6 inches in thickness and is underlain by stratified layers of brownish-gray and grayish-yellow very fine sandy loam, silt loam, fine sandy loam, and fine sand. Splotchings of rust yellow, brown, pink, and gray are common. In most places, the color of the surface soil is lighter around the edges of the separate bodies than in the centers, as materials from higher surrounding soils have been washed over the surface

and later influenced by organic matter. The reaction is neutral or slightly acid in the surface soil, but the subsoil is alkaline.

This lighter textured soil is inextensive and is developed only in small bodies. It is associated mainly with areas of Arkport fine sandy loam, smooth phase, and Berrien loamy fine sand and occupies some of the depressions, swales, troughs, or lower positions through those soils.

Included areas of loam differ from Colwood silt loam chiefly in the color of the substratum, which is gray, whereas the typical silt loam has a brighter colored or pink substratum. The total acreage of this included soil is small. Most of this land is in hay or pasture fields, but small areas adjoining cultivated soils are used for the production of buckwheat, oats, corn, hay, and vegetables. Yields are influenced by drainage and seasonal conditions and are a little below the average for the county.

HEAVY SOILS

Toledo silty clay loam.—The 5- to 8-inch surface layer of Toledo silty clay loam is very dark gray or dark brownish-gray granular silty clay loam or heavy silt loam, which, when moist, appears much darker than when dry. It is underlain by a 2- to 4-inch layer of light-gray or gray heavy silty clay loam or clay, containing rust-colored mottles. This material grades into heavy, tight, blocky clay variously colored with shades of gray, yellow, and dull brown. The substratum is dull brownish-yellow or yellowish-brown tight compact clay or silty clay loam, mottled with gray, dark gray, rust yellow, and rust brown, but to less degree than the layer above. It also contains gray seams of lime material. In most places, this soil is free of stony fragments. The materials composing it are lake-bed deposits, but exposures show little stratification. They are derived from calcareous shales and silt.

This soil occupies poorly drained flats, swales, and depressions, which have the lowest positions in the sections where they occur. The soil is associated with Dunkirk silt loam and Fulton silty clay loam in the northern part of the county. Many of the areas occur as long narrow swales forming a winding network between adjoining soils. Several bodies are in the southern part.

This soil receives drainage from surrounding higher soils, and the water seeps away very slowly, sometimes remaining on the surface and keeping the soil wet for a long time. When the soil dries during the summer, it contracts, and cracks form. In some of the wetter areas, a thin layer of decaying vegetable matter covers the surface.

Only a small acreage of Toledo silty clay loam has been put under cultivation. It is not an extensive soil and is agriculturally unimportant. Wood lots consist largely of elm and maple but include hickory, ash, oaks, and thorn apple. In the broader swales water-loving grasses and sedges are abundant. In its natural state of poor drainage the soil has little agricultural value. Its inherent fertility is good, but the land is hard to handle. Hay is the main crop, and small areas are used for the production of corn, beans, and special crops. Yields are uncertain on account of poor drainage. Under

present agricultural conditions, this land is best suited to pasture, hay, and forestry.

Toledo silt loam.—The typical surface soil of Toledo silt loam, to a depth ranging from 6 to 10 inches, is dark brownish-gray or dark-gray friable mellow silt loam. This grades into an irregular mixture of silt loam, clay, and sand showing more or less stratification and extending downward to a depth of 5 feet or deeper. The material is dominantly silty in texture, although in places clay is dominant for short distances. The colors of these materials are dull shades of yellow, gray, and brown, all containing rust-colored stainings in various proportions. Some variations in color and texture occur in the surface soil. In places the texture is very fine sandy loam or loam. A veneer of brown or brownish-gray silt, eroded from higher adjoining soils, has been deposited irregularly on the surface, particularly on areas occupying narrow depressions.

Although this soil is widely distributed across the northern part of the county and has a limited distribution elsewhere, the total acreage is comparatively small. It occurs in many narrow elongated interconnected channels winding through and between areas of Dunkirk silt loam and Fulton silty clay loam, but some areas occupy basins, flats, and gentle slopes. Both surface and internal drainage are deficient, and in its natural state this soil is only slightly better drained than Toledo silty clay loam. Some improvement of drainage has been attempted in places.

About 85 percent or more of the land has been cleared and either is cultivated for field crops or is used as hay or pasture land. It occupies but a small part of the soils comprising a farm. The acreage under cultivation for field crops is small. Corn, oats, barley, and vegetables are grown, and yields range from low to good, as influenced by drainage and management.

Most of the trees in apple, cherry, and peach orchards, extended from better drained soils, show the detrimental effects of poor drainage and aeration. Pear and quince trees show more favorable growth.

This soil is considered good grassland and is suitable for permanent pastures in the broader areas, but for cultivated or special crops, improved drainage is essential to insure profitable yields.

Poygan silt loam.—The 6-inch surface layer of Poygan silt loam consists of dark-gray or dark brownish-gray mellow silt loam. It is underlain to a depth of 9 inches by a layer of light-gray or grayish-yellow smooth mellow silt loam containing some splotches of rust yellow and rust brown. Below this and extending to a depth of 40 inches is light pinkish-brown, light reddish-brown, or salmon-colored silt loam interstratified with thin horizontal lenses of very fine sandy loam and clay, similar in color to the silt loam material and all stained to some degree with light-gray and rust-colored mottles. The dark colors of the surface soil are influenced by the content of decayed vegetable matter. When moist the soil material is very dark or almost black to a depth of about 12 inches in places, but in few places to a depth of less than 5 inches. Below the surface layer is a contrasting light-colored layer which in places is whitish gray with no staining and in others is a blending of dull shades of yellow, brown, and gray. The soil material in general is smooth, floury,

mellow, and fairly free of gritty matter. It extends to a depth of 5 feet or deeper in most places. The surface soil is not acid, and the material in the lower layers is calcareous. In one or two areas there is a sprinkling of broken shell fragments over the surface and through the subsurface layers. Although the texture is typically silty, spots of loam and silty clay loam occur in places. When the surface soil is dry, cracks ranging from one-fourth to three-fourths of an inch in width form.

This soil is derived from old lake-bed materials deposited on flat poorly drained areas. It occurs chiefly in the towns of Barre and Shelby, in association with areas of the Collamer, Petoskey, Schoharie, Ontario, Honeoye, and Hilton soils, where it occupies lower positions than the surrounding soils. In its natural condition, the lower part of the soil is moist the greater part of the year. The land warms very slowly in the spring, on account of its saturated condition.

This soil is but little developed for agriculture because of its inadequate natural internal drainage. Only small selected areas are cropped, and in some seasons production is good. About 85 percent of the land is in pasture or is used for hay crops. The pasture fields support a native vegetation including a mixture of coarse moisture-loving grasses. Some fields are devoted to the growing of timothy and alsike clover for hay. Corn, oats, some buckwheat, and beans are grown, and a small acreage is devoted to tomatoes and cabbage. A spotted nonuniform growth results on all fields, because of different soil conditions and drainage. Attempts have been made to improve the drainage on some farms by ditches. Wheat has yielded a maximum of 45 or more bushels an acre, corn 100 bushels, and oats 75 bushels. Yields are influenced by the character of the underlying soil material and local drainage conditions.

Large areas of this soil, in association with other poorly drained soils, occupy large belts of land in some parts of the county, that offer little returns from cultivated crops. Under existing economic conditions, such land offers better possibilities for pasture and forestry. Part of the land is forested with mixed hardwoods.

The surface soil of some areas of Poygan silt loam is dark brownish-gray or medium dark-gray silt loam, several shades darker than the typical surface soil, and the subsurface layer, at a depth of 6 or 8 inches, is grayish-yellow or light-gray silt loam mottled with yellow and brown. The subsoil, at a depth ranging from 10 to 15 inches, is light chocolate-brown or light reddish-brown silty clay loam, with some faint staining of yellow and gray. This material grades downward into lighter shades of reddish-brown or pinkish-brown stratified layers of silt loam, very fine sand, and clay. The soil in such areas shows less uniformity in texture, color, and structure than the typical soil. Slight differences of elevation have influenced the stage of oxidation and color of the soil layers. The immediate surface soil in cultivated fields has a very spotted appearance as regards color. Small irregular sandy spots, intricately combined in the soil, add to its variable character. Some of the included sandy spots are similar to Granby fine sandy loam and Berrien fine sandy loam. The change from silt loam to silty clay loam or fine sandy loam within a few feet is a common occurrence. Areas of

this variation are mapped mainly in Shelby and Barre Towns, where the soil is associated with other soils occupying old lake plains and terraces.

Poygan silty clay loam.—To a depth ranging from 3 to 9 inches, Poygan silty clay loam consists of dark-gray, dark grayish-brown, or dark brownish-gray friable silty clay loam. This is underlain by a layer of silty clay loam or heavy silt loam, extending to a depth of 12 or 14 inches, which is varicolored with a blending of dull yellow, brown, and gray, and contains light-gray and rust-colored splotches, the gray predominating in the wettest places. Below this the material consists of light reddish-brown, pinkish-brown, or light chocolate-brown tight heavy intractable clay containing mottles of yellow, rust brown, and light gray. On drying, the material breaks into irregular cloddy fragments having little friability. At a depth ranging from 20 to 24 inches, the substratum consists of more friable lighter clay interbedded with silt loam. The soil mass in most places is free of gravel and boulders, but a few are scattered over the surface where this soil adjoins soils containing such fragments.

The areas of Poygan silty clay loam are nearly flat. The soil occurs principally on old lake plains or terraces throughout the southern part of the county, associated with the Ontario soils and muck. On most farms this is one of the less extensive soils. The size of individual areas ranges from a few to 100 or more acres.

About 90 or 95 percent of the land has been cleared, and most of it is used as pasture or hayland in connection with general farming and dairying. Some of it is planted to corn, oats, wheat, potatoes, beans, and buckwheat, but yields are low under the prevailing seasonal and drainage conditions. It is fertile land, but the heavy character of the soil material and inadequate drainage are factors that make it hard to handle and cultivate properly. Consequently, it is considered more suitable for the grazing of livestock or the growing of grasses for hay.

Collamer silt loam, poorly drained phase.—Collamer silt loam, poorly drained phase, has a 6- or 8-inch surface layer of brownish-gray or light grayish-brown smooth fine silt loam. This is underlain by a 3- to 7-inch layer of light-gray smooth silt loam containing rust-colored mottles of yellow and brown and streaked with irregular horizontal seams of light-brown or pinkish-brown silt loam. In most places this material is underlain by heavier textured material consisting of pinkish-brown fine smooth gritless silty clay loam or clay, stained lightly with rust brown, light gray, and yellow. The structure is slightly compact or tight. Thin interbeddings of silt loam of similar color occur at irregular intervals in this layer which extends to a depth ranging from 18 to 22 inches. Below this the material is characterized by light grayish-pink or pinkish-gray faintly compact smooth floury alternating layers of very fine sandy loam and silt loam, streaked to various degrees with rust brown, yellow, and gray. The materials are thinly laminated, and in places the separate layers are only one-fourth or one-half inch thick.

The surface soil in slight depressions or wet spots is darker than typical, but when dry the immediate surface layer appears gray. Few stones or gravel occur within the soil, and for the most part all the material is free of grit and has a smooth flourlike feel. An ex-

posed profile shows principally stratified layers of silt and very fine sandy loam, with only moderate interbedding of heavier materials. The character of the soil particles is such as to allow adequate drainage, but, owing to the flat smoothly undulating relief and low topographic level, the soil has deficient underdrainage. There are few natural drainageways sufficiently close to this land to lower the water table.

This soil occurs in comparatively small scattered bodies, mainly in the southern part of the county. It occupies an intermediate agricultural and drainage position between Poygan silt loam and Schoharie silt loam. A few small areas are mapped in the northern part, in which drainage conditions are similar, but the underlying layers are reddish brown and the interbedded sandy material is coarser textured. The agricultural value of these areas is the same as that of other areas of this land.

A few wood lots, consisting dominantly of elm and maple, and including some beech, oak, ash, and hickory, are on this soil. The largest acreage is devoted to hay. Some of the hayfields are used for pasture for a few years before being plowed. The land is not cultivated extensively, owing to its inadequate underdrainage and its slowness in drying and warming in the spring. The soil is of moderate fertility. The principal crops are timothy, clover, potatoes, corn, and oats, and parts of fields are used for cabbage, tomatoes, field beans, and peas. Yields are influenced by seasonal conditions and management of the land. In wet years they are below the average for the county, but where the land has been improved by ditches, increased production has more than repaid the cost of such improvement. Parts of a few orchards have been extended to the outer parts of this soil from adjoining land, but in general this land is avoided for orchard trees because of its low position and wetness. Dairying is a common industry on farms including Collamer silt loam, poorly drained phase, Poygan silty clay loam, and Schoharie silt loam.

LIGHT-TEXTURED SOILS WITH HEAVY SUBSOILS

Wauseon fine sandy loam.—Wauseon fine sandy loam, to a depth of 10 inches, consists of dark-gray fine sandy loam, loamy fine sand, or light loam. This is underlain to a depth of 14 inches, by light-gray or ash-gray slightly compact loamy fine sand or loamy sand with some faint staining, which grades horizontally into yellow or yellowish-gray similar-textured material containing rust-colored mottles. Between depths of 14 and 29 inches, the material consists of a mixture of yellow, brownish-yellow, and grayish-yellow loamy fine sand or fine sandy loam, splotched with light gray, rust yellow, and rust brown. This material is moderately coherent and in places is somewhat compact. Below this and extending to a depth of 45 inches, is brownish-gray, gray, or dull grayish-brown heavy smooth calcareous clay streaked with light gray and rust brown.

Most of this soil contains very few gravel or pebbles. The gravelly areas are indicated by gravel symbols on the accompanying soil map. The deposition of sandy material over the clay formation ranges in thickness from about 15 to 40 inches. Where the sandy deposit is shallow, the material above the clay in most places is light gray.

Some areas of Wauseon very fine sandy loam are included in mapping.

In general Wauseon fine sandy loam is associated with the Rimer, Berrien, Fulton, and Toledo soils. It occurs in small bodies scattered across the northern and southwestern parts of the county. It is of small total extent. Its characteristic occurrence is in broad flats, swales, or depressions, but the larger areas include some small knolls. Drainage is poor, and the sand remains moist or wet during a large part of the year.

Less than 5 percent of this soil is cultivated, and the rest is in pasture or forest land. Cultivated areas, most of which are transitional between typical Wauseon fine sandy loam and the adjoining soils, are used for field crops and vegetables. A few fruit trees have been planted on the outer edges of areas of this soil, but the trees are less vigorous and in poorer condition than the trees on better drained land.

Wauseon fine sandy loam represents a shallow phase of Granby loamy fine sand over heavy clay. Under present economic conditions, the soil has about the same limitations for agricultural use as has the Granby soil.

SOILS WITH HEAVY OR COMPACT SUBSOILS AND SHALLOW OVER ROCK

Brockport silt loam, imperfectly drained phase.—Brockport silt loam, imperfectly drained phase, consists of dark brownish-gray or dark-gray silt loam or silty clay loam to a depth ranging from 3 to 7 inches, where it is underlain by gray, light-yellow, or light yellowish-gray heavy waxy cloddy clay mottled with rust yellow. This material merges, at a depth ranging from 15 to 20 inches, into light-gray less heavy clay which also contains rust-yellow mottles. The material in this layer has a laminated structure and is more friable and less compact than that in the layer above. It contains masses of partly weathered thinly laminated gray calcareous shale.

This soil is derived largely from the decomposed underlying calcareous shales. Shale rock is mixed through the soil mass and predominates over other rock fragments, but some spots contain very little stony material. The thickness of the soil material is comparatively slight, and bedrock, in some places, lies at a depth ranging from 35 to 50 inches.

This is one of the less extensive soils. It occurs in parts of Shelby and Murray Towns, where it is associated with typical Brockport silt loam. Small scattered ridges of typical Brockport silt loam are included with land mapped as this phase. Soil of the imperfectly drained phase occurs in depressions and flats and on the lower parts of gentle slopes, the upper parts of which are occupied by adjoining soils, and it receives their drainage and seepage.

A few acres only, around the borders of adjoining soils, are cultivated, and the rest of the land is in pasture or in wood lots. This is a difficult soil to manage, on account of its clayey texture, compact structure, and inadequate drainage. Hay is cut from some of the pasture fields which support a cover of bluegrass, white clover, creeping bent, and many different weeds. Much of the grazing land includes a combination of the imperfectly drained phase, areas of the typical soil, and gravelly areas.

Land of this character has a low selling value and generally is avoided for general cropping purposes.

Lyons silt loam, shallow phase.—The upper layer of Lyons silt loam, shallow phase, is medium brownish-gray or medium dark grayish-brown silt loam which grades, at a depth ranging from 8 to 12 inches, into dull-gray heavy silt loam or silty clay loam, stained with rust yellow. This material rests on limestone at an average depth of about 20 inches. A thin layer of yellowish-brown material mottled with gray and weathered from the limerock is present in places.

Lyons silt loam, shallow phase, occupies depressions within areas of the Farmington soils. It occurs in scattered bodies throughout the southern part of the county, the largest number being in Shelby Town. Most of the land is used for hay or pasture in association with the surrounding soils, but in places the outer edges of areas are farmed and managed like the adjoining dominant soils. This soil is of only local importance and occupies but a small acreage on any one farm. It is of limited fertility and produces low average yields.

Small areas of silty clay loam are associated with this soil.

A few small areas of soil having a loam texture cover a very small acreage in Murray Town. Parts of them are cultivated with adjoining soils, but the larger areas are used for hay or as permanent pasture. The yield of cultivated crops is lower than the average for the county. This land has a comparatively low agricultural value because of its shallowness and low productivity.

Lockport silty clay loam, poorly drained phase.—The surface soil of Lockport silty clay loam, poorly drained phase, is dark-gray or very dark grayish-brown granular silty clay loam to a depth ranging from 4 to 10 inches. The upper part of the subsoil is a combination of yellow, yellowish-gray, and light-gray clay with gray mottles and light reddish-brown clay streaked with yellow, brown, and gray, and contains tongues of material from the surface soil. The lower part of the subsoil contains more reddish-brown material and fewer mottles, and, at a depth ranging from 15 to 20 inches, merges into deep reddish-brown or brownish-red smooth clay streaked with gray, dark gray, or greenish gray. This clay is largely decomposed red shale, and in most places red shale rock is reached at a depth ranging from 40 to 50 inches.

Boulders ranging from 1 to 2 feet in diameter, cobbles, gravel, and angular flat stony fragments, derived from sandstone, shale, crystalline, and granitic formations, are mixed through the soil. Although the texture is fairly uniform, the soil includes small areas of silt loam and clay. A few sandy pockets occur in the subsoil, and, where this soil is associated with sandy ridges, sand spots are noticeable over the surface.

Soil of this phase is intimately associated with areas of typical Lockport silty clay loam. It occupies the slightly depressed areas, and rain water passes away very slowly. Passage of water through the subsoil is retarded by the heavy material, and downward percolation is stopped almost entirely by the compact structure of the substratum. Water remains over the surface for a long time during some seasons of the year.

Many of the cleared areas are covered with characteristic vegetation that includes sedges, rushes, reeds, cattails, and moisture-lov-

ing grasses. Wooded areas support a mixed growth of elm, hickory, swamp oak, soft maple, ash, beech, alder, birch, and other trees requiring plenty of moisture.

The principal use of this soil is for permanent grazing land, in association with areas of the typical soil, but many fields are lying idle. The pasture value is low, on account of the undesirable growth of vegetation, and consequently the selling or rental value of the land is low. Together with areas of the typical soil, this land is rented by some farmers for sheep pasture. It is considered one of the less desirable farming soils.

SOILS WITH COMPACT SUBSOILS

Lyons loam.—The 6- to 9-inch surface layer of Lyons loam consists of dark-gray or dark grayish-brown gritty silt loam. It is underlain by dull brownish-yellow or yellowish-gray heavy silt loam or silty clay loam, mottled yellow and gray and grading into the subsoil at a depth of 12 or 14 inches. The subsoil consists of dull grayish-brown gritty clay loam streaked with rust yellow and light gray. Below this, at a depth ranging from 22 to 26 inches, is the substratum of light brownish-gray or pale grayish-brown moderately compact or compact but friable loam or heavy fine sandy loam, stained with light gray and rust yellow.

Like other soils in this county, which are influenced by considerable ground water, the color profile of Lyons loam is characterized by a variety of colors and shades. Some minor differences of texture occur also. As developed here, the surface soil includes a mixture of grayish-brown, dark-gray, very dark gray, and brownish-gray colors. In places where this soil merges with Ontario loam and Hilton loam it assumes browner shades, and adjoining muck soils it is darker than typical. The texture ranges from loam to light silty clay loam, but silt loam predominates. The subsoil is heavier in texture than either the top layer or the substratum. The substratum, or partly weathered layer, is chiefly unassorted material, although some areas include spots of stratified materials having like color and textural variations. The stony fragments mixed with the soil are mainly limestone but include sandstone, shale, and granite. In a few places, there are large rounded boulders ranging from 2 to 4 feet in diameter, which have become pitted during the process of weathering.

This soil is of moderate extent. It is derived from materials similar to those forming the Ontario and Hilton soils, but development has been modified or retarded by lack of oxidation. The soil is associated with the Hilton, Cazenovia, and Ontario soils and muck; and it occurs in depressions, at bottoms of slopes, in swales, and in low-lying flats. Drainage is fair or poor, owing to the unfavorable location of the areas and the compact structure of the subsoil, that retards downward percolation. The bodies range in size from 1 to 200 or more acres, and they include small knolls or ridges of Hilton loam and Ontario loam.

Areas of Lyons loam are so distributed that they are not important in any one section, although the soil is extensive enough on some farms to be a problem in management. About 95 percent of the land is cleared of its original mixed hardwood growth. A large pro-

portion of the soil adjoining muck areas is fenced and maintained for permanent pasture, and other areas are used for the production of hay. Border belts adjoining Ontario loam, Cazenovia loam, and Hilton loam are cultivated for corn, oats, wheat, hay, cabbage, tomatoes, and beans. Crop yields average somewhat lower than on the associated soils, although in some years they are higher. Improvement of drainage gives increased yields.

Pear and quince orchards are established on some areas of this soil, and yields are fair. In places where the acreage in apple orchards has been enlarged to include Lyons loam, the trees on the Lyons soil are smaller, less healthy, and produce lower yields. Some fruit trees have died as a result of insufficient drainage.

In places where Lyons loam is associated with Hilton loam it has a surface layer of dark-gray mellow loam or light silt loam extending to a depth of 5 or 7 inches. This is underlain by a 3- or 4-inch layer of light-gray, dull-gray, or yellowish-gray heavy silt loam or light silty clay loam, moderately stained with gray and yellow. Below this is grayish-yellow or pale dull-yellow moderately friable heavy silt loam or silty clay loam, mottled heavily with yellow and a mixture of light gray, rust yellow, and rust brown. This material merges quickly, at a depth ranging from 20 to 25 inches, into the substratum which consists of pinkish-brown or light reddish-brown very compact very fine sandy loam, very fine sandy clay loam, or fine sandy loam, containing light streaks of yellow, brown, and gray. Small rounded pebbles are present throughout this layer. A quantity of flat, angular, and rounded cobbles and boulders are scattered over the surface and through the soil. The relief ranges from flat to faintly undulating. Internal drainage is inadequate and is restricted by the flat surface and slowly impervious character of the substratum. Such areas occur in a few small bodies in Ridgeway and Shelby Towns.

Lyons silt loam.—The surface layer of Lyons silt loam, to a depth of 6 or 8 inches, is dark brownish-gray or very dark gray silt loam, together with some light silty clay loam. The topmost 2 or 3 inches of soil is somewhat darker and more granular, owing to the larger content of organic matter. This layer is underlain by an irregular mixture of light-gray heavy silt loam or silty clay loam and grayish-yellow or dull yellowish-brown material of similar texture containing rust-colored mottles. This layer ranges from 2 to 4 inches in thickness. Below this is dull yellowish-brown or dull-brown heavy silty clay loam or clay, streaked with light gray and rust brown and containing small aggregates of light reddish-brown material. Pockets of dull-yellow and brown gritty clay loam, splotched to some degree with light reddish brown, occur in this layer. These inclusions are materials similar to those in the lower part of Hilton loam. The material in this layer consists of water-deposited sediments mixed with glacial till. It continues to a depth ranging from 20 to about 30 inches. The substratum consists of light grayish-brown gritty compact fine sandy loam or loam, with small masses of grayish-pink or light reddish-brown material of similar texture.

This soil occupies some of the flat smooth areas or depressions within areas of Hilton loam and Clarkson loam, and consequently

it has some characteristics of each. It is practically free of cobbles and gravel, except in narrow strips bordering soils containing such stone fragments. In places the texture is light silt loam or very fine sandy loam. This soil represents an intermediate condition between Toledo silt loam and Hilton loam. Drainage is poor and is similar to that of Toledo silt loam. Some areas are in small catch basins which have no natural outlet. Many of the bodies are small, ranging from 1 acre to about 20 acres in size.

The most extensive use of this soil is for pasture and hay. The pasture grasses include creeping bent and Canada bluegrass, mixed with thistles, teasel, sedges, foxtail, and coarse grasses. Some hay-fields produce good yields of timothy and alsike clover. Drainage of parts of some areas has been improved, and they are used for the production of corn, buckwheat, small grains, and vegetables. This is a soil of high fertility, but crop results are uncertain, owing to drainage conditions. Because of its position and poor drainage, this soil can be classed with those soils most suitable for forestry and pasture land.

Some areas mapped with Lyons silt loam have angular and rounded fragments of limestone, sandstone, and shale scattered irregularly over the surface and through the soil. The stones are abundant in places and scarce in others. This soil is of small extent, but it is widely distributed throughout the limestone section of the county. It occupies catchment basins, depressions, swales, or troughs, that are difficult to drain thoroughly. It is associated with Hilton loam, Lyons loam, Schoharie silt loam, Ontario loam, and muck. A common position is between glacial-till and water-deposited soils.

Some areas of Lyons silt loam are subject to a high water table that keeps the soil moist most of the year. No individual body is farmed entirely, but selected tracts or narrow strips are cultivated in places where this land adjoins better drained land.

Hilton loam, poorly drained phase.—The poorly drained phase of Hilton loam has a 5- to 7-inch surface layer of dark-gray or dark brownish-gray loam, silty loam, or light silt loam. The intensity of the color varies, according to the moisture and organic-matter content. This layer is underlain by a 2- to 7-inch layer of irregularly developed light-gray or gray loam, with yellow stainings, which grades horizontally into mottled yellow and gray loam or silt loam. In places this material is strongly leached of color and contains but few mottles, but such a condition extends for a distance of only a few feet, and the material blends with varicolored material. Below this is a layer of light dull-brown or brownish-yellow fine sandy clay loam mottled to different degrees with gray, yellow, reddish brown, and pink. The material is lightly or moderately compact, but it is friable when disturbed. It extends to a depth ranging from about 10 to 15 inches. The substratum is light pinkish-brown or light reddish-brown fine sandy loam or very fine sandy loam, largely unassorted material, though in places it includes bedded layers. The soil material contains a mixture of cobbles, gravel, and boulders, derived mainly from red sandstones and shales and including crystalline and granitic fragments.

This soil is related to Hilton loam and Clarkson loam, in that it has developed from similar materials, but it occupies an inferior drainage position that favored a greater accumulation of organic matter in the surface soil and a leaching of colors in the underlying layers. The soil as mapped includes spots of Hilton loam and Lyons silt loam. It differs from Lyons loam in that a gray horizon is developed above the compact zone, and in that the deep substratum is less compact. There is less clay in the subsoil than in Lyons silt loam.

The poorly drained phase of Hilton loam is a soil of small extent and of little agricultural importance, as all the areas are small and of only local significance on individual farms. Most of the land is in sod or is used for grazing in combination with adjoining soils. This land is wet and would require expense, time, and labor in improving it for cultivation. Parts of some areas are farmed with adjoining soils to general field crops or to special crops, such as tomatoes or cabbage. Yields of cultivated crops are variable, according to the degree of drainage.

SOILS DERIVED FROM ORGANIC ACCUMULATIONS

Bono loam.—Bono loam is somewhat different from other soils, as the composition of the upper part is largely organic matter, with a small admixture of mineral matter. Other soils of the poorly drained group contain decayed vegetable matter, but the mineral constituents predominate, whereas in Bono loam this condition is not so pronounced.

The 6- to 10-inch surface layer of Bono loam is very dark gray mucky loam or mineralized organic matter. The organic matter is well decomposed, is granular, and is mixed with sufficient silt, sand, and clay particles to impart loaminess to the texture. It is underlain by a thin layer of bluish-gray or dull-gray silty clay loam, silt loam, or light clay streaked with light gray. This is a transitional zone that grades, at a depth of 12 or 15 inches, into layers of stratified mineral material. These strata are for the most part heavy textured, consisting of light-brown, pinkish-brown, or grayish-pink light clay or silty clay, with gray, yellow, and rust-brown mottles and interbedded with thin layers of silty material. In the lower layers is some fine-textured sand. Bono loam occurs in scattered areas in the southern part of the county, in association with muck, and in some places it constitutes a narrow belt between a mineral soil and an organic soil.

A few wood lots are on this land, but most of the areas are cleared and used for permanent pasture. Sometimes narrow strips are cultivated with an adjoining soil. Poor drainage is a hindrance to profitable yields on this land. The soil is suitable for pasture land and supports a fairly good growth of grass including wild clover, creeping bent, bluegrass, and many weeds. Few attempts are made to improve the pastures. The selling value of the land is comparatively low.

Muck.—Muck is an organic soil resulting almost entirely from the breaking up and decomposition of vegetable matter. It is distinctly different from mineral soils and has peculiar inherent characteristics.

The upper layer is blackish-brown or very dark grayish-brown fairly well decayed organic matter containing a small admixture of silts and clays, that have been washed in from the uplands. When the material is wet, the color appears nearly jet black. To a depth ranging from 10 to 18 inches, nearly all evidence of its former composition has disappeared. The material is granular, crumbly, smooth, of light weight, slightly compact, and contains little fibrous or woody matter. A mass of slender roots, from a recent growth of grass or crop plants in various stages of decay, is present in the upper part. In the lower part, the decay of organic matter is not so advanced, and the material is more woody and fibrous. In places, the remains of tree stumps, roots, and other woody material having the characteristics and color of punk, are plentiful; but surrounding these spots, the materials are more decomposed, the original character of the vegetation is not readily discernible, and much of the material is like the upper part of the soil in color and structure. The deepest areas contain thin strata of brown or brownish-gray felty matted fibrous masses of material derived from sedges, reeds, mosses, and water-loving grasses. The top layer of areas recently cleared of tree growth contains a large admixture of woody debris.

A profile of muck shows horizontal laminated layers, each containing some undecayed or partly decayed wood, or roots from grasses, trees, and other vegetation that grew on the next layer below. These layers contain large tree stumps and roots, which penetrate many of them for some depth and extend into the underlying mineral soil in places. Many of the tree stumps, although changed in color and composition, retain much of their original form.

Muck comprises areas in which the organic material extends to a depth greater than 40 inches, and in some places the deposit reaches a depth of 15 feet. The material is slightly acid from the upper layer down. At times, in cultivated areas a thin white film, that is an accumulation of lime salts and has an alkaline reaction, covers the surface in places, but in only a few bodies, several feet in diameter, have alkali spots detrimental to plant growth been formed.

Nearly all of the muck areas are confined to and distributed through the southern half of the county, where they occupy a total area of several square miles. The largest body extends for a considerable distance across the southern boundary. This is locally known as Oak Orchard Swamp and is one of the largest muck areas in the State.

Muck occupies depressions or old filled-in lakes and ponds. In its natural condition it is very poorly drained, owing to its practically flat relief, with little or no slope. The water table is high, and water stands over much of the land very late in the spring. Muck remains in a moist or saturated condition for a considerable part of the summer.

The tree growth, from which much of the upper part of this organic soil is derived, consists of elm, maple, hickory, black ash, birch, tamarack, basswood, blue beech, swamp oak, hemlock, pine, and alder. The undergrowth includes ground hemlock, bushes, reeds, ferns, coarse grasses, briars, vines, and other water-loving vegetation, but in only a few small places is the tree growth sufficiently thin to allow the growth of reeds, rushes, and cattails.

Muck is of agricultural importance. It is considered very desirable for truck crops, and about 40 percent of it has been cleared and reclaimed. Several organizations control a large acreage of muck land. Much of the cleared land has been improved by the construction of large open main ditches, with numerous connecting small laterals that extend to all cultivated fields.

Most of the cleared areas are farmed intensively to truck crops, and some of them are maintained in permanent pastures. The larger bodies are cultivated by specialists who devote their entire time to the growing of truck crops. Some farmers cultivate both mineral and muck soils.

The leading crops on muck land are onions, celery, lettuce, and carrots, and some potatoes, cabbage, corn, tomatoes, beans, asparagus, beets, and cauliflower are grown. The vegetables are fertilized heavily, and acre applications of 2-8-10, 4-12-4, 5-10-5, 3-12-18, or 4-18-12 mixtures, ranging from 1,000 to 2,000 pounds, are used for various crops. Some crops are given a side dressing of nitrate of soda in addition to the regular fertilizer application. Acre yields of onions range from 300 to 500 bushels, and in some seasons the production is higher; lettuce 600 to 800 crates; celery 150 to 300 crates; carrots 400 to 600 bushels; and other crops yield well. In the Oak Orchard Swamp area, danger to crops from wind injury is curtailed by windbreaks consisting of willows planted along the lateral ditches.

Crop rotations are followed on this land and up-to-date intensive cultural methods are practiced. One vegetable may be followed by the same crop or grown in rotation with onions, lettuce, carrots, celery, or potatoes.

Well-improved muck has a high selling value and is priced above the better grade mineral soils, but some tracts, because of their location and the cost of drainage, sell for a low price.

Muck, shallow phase.—A considerable acreage of muck is shallow, ranging from about 10 to 30 inches in thickness, with an average depth of approximately 20 inches. The vegetable matter comprising the upper part is well decomposed and dark colored, but the material is variable in the lower part, as in the deeper muck. The underlying mineral material is composed of stratified layers of gray or light-colored clay and silt, with thin interbeddings of sand, and in some places it consists entirely of bedded sand. The top part of the underlying clay layer in most places is intermixed with a thin stratum of peaty material derived largely from mosses, flags, reeds, sedges, and other aquatic vegetation. The mineral layers are calcareous, in contrast to the acid character of the organic matter.

Some entire areas of muck consist of the shallow phase, with no inclusions of the deeper muck. The deposit in such bodies is not uniform and in general is more shallow around the edges. Some of this shallow muck occurs as narrow borders along areas of the deeper material.

Between 85 and 90 percent of the shallow muck supports a tree growth, and most of the rest is used for permanent pasture. A small acreage, divided among small tracts, is used for truck crops. Cultural methods and crop yields are similar to those on the deeper muck.

Edwards muck.—Some areas of shallow muck underlain by marl are classed as Edwards muck. The material in such areas consists of a 10- to 25-inch layer of very dark brownish-gray or brownish-black granular well-decomposed organic matter containing live and dead plant roots and woody material from the vegetation covering the soil. It grades into thinly laminated gray silty material with an intermingling of felty stringy brown peat and a small quantity of marl. This layer is from 2 to 4 inches thick and rests on gray or grayish-white marl which, in places, is stained with yellow and contains small broken shell fragments. The marl ranges from 10 to 35 inches in thickness and rests on layers of clay and silt. The main developments of Edwards muck are at Mutton Lake and in the vicinity of Clarendon. Parts of the areas are cleared, the water table lowered by ditches, and the land used for the growing of truck crops.

Peat.—Peat is an accumulation of organic matter which has undergone very little decomposition because of extremely poor drainage. It occupies former lakes or ponds where the water remains stagnant for long periods. This material is derived from plants of several varieties, including sphagnum moss, other mosses, reeds, ferns, cat-tails, sedges, coarse grasses, and huckleberry bushes. Tamarack, alder, and water-loving brush and shrubs are encroaching on the peat areas and contributing to the vegetable debris.

Peat contains very little mineral matter. The upper part is matted thinly laminated raw dark-gray organic material showing very little decay. It consists of leaves, twigs, and roots from the vegetation growing on it. Below a depth ranging from 4 to 6 inches, is a light-brown or light reddish-brown mixture of fibrous, stringy, felty, and partly decayed organic matter, together with brownish-gray smooth material more advanced in decay.

The water table occurs near or over the surface most of the year, and the material is in such a saturated condition that oxidation of the organic matter has been negligible, imperfect, and uneven.

Peat remains unimproved and has no agricultural value. It occurs only in several small bodies in Barre Town.

ALLUVIAL SOILS

Alluvial soils represent soil materials carried and deposited in the valleys by streams. The materials, chiefly of local origin, are washed from the nearby upland soils. Some of the alluvial soils occupy high benches, or terraces, above overflow, as the sediments giving rise to soils in such positions were deposited before the streams had cut down to their present levels. Other alluvial soils occupy the lowest areas in the locality in which they occur and are subject to inundation during floods. The soils of this group are divided into several series, based largely on drainage characteristics.

Genesee silt loam.—The surface layer of Genesee silt loam ranges from 6 to 14 inches in thickness and consists of brown, light-brown, or dark-brown mellow smooth silt loam which, when dry, is grayish brown. It is underlain by brown, bright-brown, or yellowish-brown granular and faintly compact heavy silt loam that continues downward with uniform texture to a depth ranging from 3 to 4 feet,

where it is lighter colored or grayish brown and contains some stainings of gray, yellow, and rust brown. The deeper material consists of stratified silts and sands.

Along the upper reaches of streams, the deposits of sediments are comparatively thin, whereas in the wider valleys, the soil material ranges from 5 to 15 feet or more in thickness. The surface layer is slightly acid, but the lower layers contain lime material. In places along stream banks, the soil develops a browner color than typical and includes narrow erratic strips of lighter textured soil consisting of loam and fine sandy loam.

Genesee silt loam occupies well-drained flats or first bottoms along Johnson and Oak Orchard Creeks and their tributaries. The relief is smooth and gently sloping with a downstream gradient. A few wood lots, including elm, maple, oak, hickory, and beech trees, cover a part of the land, and, here and there, along stream banks are a few willow, beech, elm, maple, and alder trees.

More than 95 percent of this land is used for pasture, and a few small patches are cultivated for grain, corn, vegetables, or hay. This is a productive soil, and excellent yields are possible in places where flooding is prevented.

Hamlin silt loam.—The 6- or 8-inch surface soil of Hamlin silt loam is brown or grayish-brown mellow silt loam. It grades into light reddish-brown granular mellow friable silt loam which extends downward for several feet with few variations in color and texture. The thickness of the soil material in well-developed typical areas, ranges from 5 to 8 feet or more. Interbeddings of gravel and sand occur in places. Narrow strips and small areas having a loam or sandy loam texture occur along the edges of Oak Orchard Creek.

Hamlin silt loam consists of water-deposited sediments on the flood plains, and they receive wash from red shale rock material. The land is flat and lies from about 4 to 12 feet above the normal level of the streams. The structure of the soil allows good drainage between the infrequent floods, and the material is well aerated.

The greater part of this land is cleared of the original tree growth, but narrow rows of willow, alder, and elm grow along parts of the stream channels. Nearly all of this soil is used for pasture or hay land, and occasionally a few patches are planted to corn and grain, which return high yields.

Hamlin silt loam, high-bottom phase.—The high-bottom phase of Hamlin silt loam differs from the typical soil only in topographic position. It occupies some of the higher levels, or benches, of valley areas which are above ordinary high floods, and in such locations is more suitable than the typical soil for cultivation, with little or no risk from inundation. It is of very small extent. All the land is cleared, and the greater part is used as hay and pasture land, but small areas sometimes are planted to corn, oats, and wheat, all of which return high yields.

Wolcottsburg silt loam.—The 6- to 8-inch surface layer of Wolcottsburg silt loam is medium dark-gray or grayish-brown mellow friable silt loam, and the subsurface layer, which is about 2 inches thick, is dull-gray or grayish-yellow silt loam or silty clay loam, mottled with rust yellow. This material rests on dull-yellow or

dull brownish-yellow silty clay loam containing small accumulations of silt loam and very fine sandy loam and is considerably mottled with gray in places. The material is thinly laminated and breaks into small cloddy fragments. The substratum, at a depth ranging from 25 to 30 inches, is yellow slightly compact very fine sandy loam containing gray and light-gray stains.

The color of the surface soil is not uniform. In higher places or better drained locations, it is browner than typical and contains less organic matter. In depressions and on some flat areas it is somewhat darker. The soil contains a thin layer of muck in places.

This soil contains intricate inclusions of loam and very fine sandy loam in some places, and in such places the soil is characterized by a medium-textured surface layer grading into definitely heavier material that shows slight stratification and is underlain by fine-textured sandy material.

Wolcottsburg silt loam occurs only in the southern part of Shelby Town. The relief in general is smoothly undulating, but there are a few small ridges and knolls. The land frequently is saturated, and during some periods of the year the water table is near the surface. During the spring or in continued rainy seasons, this soil, in connection with other low-lying soils, is subject to flooding by backwater from Tonawanda Creek, which flows through Genesee and Niagara Counties, and by overflow waters from Oak Orchard Creek.

With the exception of the low areas on which some trees still grow, nearly all of the land has been cleared. Small tracts or fields occasionally are plowed and cultivated for corn, buckwheat, or some other crop, after the danger from high water is past. Most of the cleared land is allowed to remain in sod and is utilized for pasture or for a hay crop. On account of the hazard from floods, this land has a low selling price.

Eel silt loam.—The surface soil of typical Eel silt loam is medium dark grayish-brown or brownish-gray mellow smooth silt loam which continues to a depth ranging from 10 to 16 inches. The subsoil consists of brownish-yellow, light brownish-gray, or grayish-yellow layers of silt loam, very fine sandy loam, and silty clay loam, mottled gray, yellow, and rust brown. The soil mass contains little gravel, but the deep substratum contains thin beds of this material. Variations in the soil material include gradations toward very fine sandy loam or silty clay loam in the surface layer, and the color of the topmost material differs in proportion to the quantity of organic matter it contains and according to drainage conditions.

This soil occurs mainly in the upper or narrow parts of stream valleys. Some of it occupies narrow elongated shallow troughs that have no definite valley walls. Along the lower courses of streamways or valleys, the deposit of material is thicker than in areas along the headwaters, most of which are traversed by intermittent streams through which the flow of water is slower. The land in general is fairly flat, and internal drainage is poor. The drainage is intermediate between that of the Genesee and the Wayland soils.

Some sections of the bottoms are covered with a growth of willow, basswood, elm, hickory, soft maple, shrubs, brush, and weeds. Part of this soil is considered waste land and remains idle, but the greater

part, or about 85 percent, is maintained as meadow for farm live-stock. Most of the small acreage cultivated occurs in patches of less than an acre each and generally is planted to corn which returns medium yields.

Eel silt loam, shallow phase.—The shallow phase of Eel silt loam consists of a thin layer of inadequately drained water-laid materials deposited on the rock bottoms of the valleys. The soil consists of grayish-brown, brown, or brownish-gray mellow silt loam grading into light brownish-gray, gray, or brownish-yellow loam, silt loam, or silty clay loam, variously mottled with gray, rust yellow, and rust brown. Red shale or gray limestone formations are at a depth ranging from 5 to 20 inches. The soil material is very irregular, variations in color and texture occurring every few feet, but these differences have little significance in the value of the soil, because of its limited agricultural use. In some places, where the soil overlies red shale, a thin layer of red clay has weathered from the rock.

Soil of this phase is of very small extent. Shallow deposits over shale rock are mapped north and southwest of Millville, and north of Medina; and deposits on limestone occurring at slight depths are along a small creek in Shelby Town. This soil is used alone or in combination with other soils for pasture.

Wayland silty clay loam.—Wayland silty clay loam consists of very dark gray or very dark brownish-gray silty clay loam or heavy silt loam with rust-brown stainings, to a depth ranging from about 8 to 12 inches. This is underlain by gray or drab clay or silty clay loam mottled with yellow. In places this layer contains interstratified layers of silt loam and sandy material. The subsoil continues downward to a depth of 50 or more inches and, at a depth ranging from 5 to 10 feet, rests on unassorted materials. In places this soil occurs in intricate association with Eel silt loam.

No extensive areas of Wayland silty clay loam are mapped, although the soil is fairly widely distributed along some of the smaller streams or upper parts of tributaries to the main creeks. The flatness of the land, drainage from upland areas, and sluggish flow of the streams combine to keep this soil saturated for long periods. The soil is representative of dark-colored alluvial materials influenced by very poor drainage.

The use of the land for crops is limited. Some of it is in cleared permanent pastures, and a part still supports a stand of willows, reeds, rushes, coarse grasses, maple, and elm. Until drained and improved, Wayland silty clay loam will continue to have a low agricultural value.

Marsh.—Marsh consists of low-lying land covered mainly with a growth of cattails, rushes, sedges, and other aquatic vegetation, and on only a few areas do a few trees or shrubs grow. The land is waterlogged or is covered with water the greater part of the year. The soil material is too variable to be classed as a definite soil, as it consists of silt and clay sediments intermingled in places with peaty matter. Marsh occurs principally in a series of small areas along Oak Orchard and Bald Eagle Creeks, as these streams approach Lake Ontario. In its present condition, the land is nonagricultural and has only slight grazing value.

MISCELLANEOUS LAND TYPES

Made land.—Made land includes areas composed of material excavated from the Barge Canal or from stone quarries. Narrow irregular strips lie along the canal, where the material was heaped during construction work. The dumps about the quarries are mixtures of earth and stone fragments, piled into irregular mounds or ridges or deposited over adjoining land. Vegetation, composed of weeds, grasses, and sweetclover, is gradually spreading over some of the land, but at present made land has no agricultural value and is considered waste land.

Quarries.—As mapped in Orleans County, quarries include the open pits from which hard rock has been excavated. Some of these quarries are still in operation and are being enlarged; others have been abandoned.

PRODUCTIVITY RATINGS

The soils of Orleans County are rated in table 6 according to their productivity for the more important crops. The soil types and phases are listed in the approximate order of their general productivity under the prevailing farming practices, the most productive soils first.

The rating compares the productivity of each of the soils for each crop to a standard—100. This standard index represents the inherent productivity of the most productive soil (or soils) of significant extent in the United States for that crop. An index of 50 indicates that the soil is about one-half as productive for the specified crop as is the soil with the standard index. Soils given amendments, such as lime, commercial fertilizers, and irrigation, and unusually productive soils of small extent, have productivity indexes of more than 100 for some crops. The following tabulation sets forth some of the acre yields that have been set up as standards of 100. They represent long-time average yields of crops of satisfactory quality on the better soils without the use of amendments.

Crop:

Corn	bushels	50
Wheat	do	25
Oats	do	50
Beans	do	25
Potatoes	do	200
Apples	do	200
Corn silage	tons	12
Timothy hay	do	2
Red clover	do	2
Alstike clover	do	2
Alfalfa	do	4 ¹
Cabbage	do	12
Tomatoes	do	12

¹ Since publication of the Soil Survey of Monroe County, N. Y., the standard yield used for alfalfa is 4 tons instead of 4 $\frac{1}{2}$.

The crop index figures without parentheses in table 6 refer to the estimated productivity of the soils without the use of amendments, whereas the index figures in parentheses refer to yields under the prevailing farming practices that include the use of lime, commercial fertilizer, and manure derived from purchased concentrated feed.

TABLE 6.—*Productivity ratings of soils in Orleans County, N. Y.*

Soil ^a	Crop productivity index 1 for—										
	Corn (grain)	Corn (silage)	Wheat	Oats	Timothy hay	Red clover	Al- site clover	Pota- toes	Car- bage	Tom- atoes	Vege- table
—	1.27	2.45	2.45	2.45	2.45	2.45	2.45	2.52	2.52	2.52	2.52
—	—	—	—	—	—	—	—	—	—	—	—
Cazenovia loam	50 (80)	70 (100)	80 (100)	80 (100)	80 (100)	80 (100)	80 (100)	70 (100)	70 (100)	70 (100)	70 (100)
Ontario loam	50 (80)	60 (90)	70 (100)	70 (100)	70 (90)	70 (90)	70 (90)	60 (80)	60 (80)	60 (80)	60 (80)
Honeoye silt loam	50 (80)	60 (90)	70 (90)	70 (90)	70 (90)	70 (90)	70 (90)	50 (60)	50 (60)	50 (60)	50 (60)
Dunkirk silt loam, light-textured subsoil phase	50 (80)	60 (90)	70 (90)	70 (90)	70 (90)	70 (90)	70 (90)	60 (70)	60 (70)	60 (70)	60 (70)
Dunkirk fine sandy loam	50 (80)	60 (90)	70 (90)	70 (90)	70 (90)	70 (90)	70 (90)	50 (60)	50 (60)	50 (60)	50 (60)
Dunkirk gravelly loam	40 (60)	50 (80)	60 (80)	60 (80)	60 (80)	60 (80)	60 (80)	45 (70)	50 (80)	40 (60)	40 (60)
Dunkirk fine sandy loam, gravelly loam, shallow phase	40 (60)	50 (80)	60 (80)	60 (80)	60 (80)	60 (80)	60 (80)	45 (70)	50 (80)	40 (60)	40 (60)
Airport fine sandy loam, smooth phase	40 (70)	40 (70)	40 (70)	40 (70)	40 (70)	30 (60)	40 (80)	35 (70)	40 (80)	40 (80)	40 (80)
Clifton loam	40 (70)	50 (80)	50 (70)	50 (80)	60 (80)	60 (80)	60 (80)	25 (45)	40 (60)	40 (60)	50 (70)
Collamer silt loam	40 (60)	50 (70)	40 (70)	50 (80)	50 (80)	50 (80)	50 (80)	35 (45)	40 (60)	30 (50)	50 (70)
Schomburg silt loam	—	—	—	—	—	—	—	50 (80)	50 (80)	50 (80)	50 (80)
Lucas silt loam	50 (80)	40 (60)	40 (70)	50 (80)	60 (80)	60 (80)	60 (80)	50 (70)	50 (70)	50 (70)	50 (70)
Clarkson fine sandy loam	40 (60)	50 (80)	50 (70)	40 (70)	50 (70)	50 (70)	50 (70)	25 (45)	50 (70)	40 (60)	50 (70)
Hilton silt loam	40 (60)	50 (70)	50 (70)	60 (80)	60 (80)	60 (80)	60 (80)	25 (45)	50 (70)	30 (40)	50 (70)
Hilton loam	40 (60)	50 (70)	50 (70)	60 (70)	60 (80)	60 (80)	60 (80)	25 (45)	50 (70)	30 (40)	50 (70)
Hamlin silt loam, high-bottom phase	70 (80)	70 (90)	70 (90)	70 (90)	70 (90)	70 (90)	70 (90)	45 (55)	50 (60)	60 (70)	70 (80)
Genesee silt loam ¹⁰	70	80	40	50	50	50	70	35	50	40	50
Colchester silt loam, heavy phase	40 (90)	50 (70)	40 (60)	50 (70)	60 (80)	60 (80)	60 (80)	35 (45)	40 (60)	30 (40)	50 (70)
Archport fine sandy loam	30 (50)	30 (50)	30 (60)	30 (60)	30 (70)	30 (70)	40 (80)	35 (45)	30 (50)	30 (50)	40 (80)
Hilton fine sandy loam	40 (60)	50 (70)	40 (60)	40 (70)	50 (70)	50 (70)	60 (80)	25 (45)	40 (60)	40 (60)	50 (70)
Clarkson loam, shallow phase	40 (60)	50 (50)	50 (70)	50 (70)	50 (70)	50 (70)	50 (70)	25 (45)	50 (70)	30 (40)	50 (70)
Alton gravelly loam	40 (60)	40 (60)	40 (50)	40 (50)	40 (50)	40 (50)	40 (50)	25 (45)	40 (70)	40 (60)	50 (60)
Berrien very fine sandy loam	40 (70)	40 (70)	40 (60)	40 (60)	40 (50)	40 (50)	50 (70)	10 (55)	40 (70)	30 (50)	40 (70)
Brockport silt loam	40 (60)	40 (60)	30 (50)	40 (60)	50 (70)	50 (70)	50 (70)	25 (45)	40 (60)	20 (50)	40 (60)
Farmington silt loam	40 (50)	40 (60)	40 (60)	40 (60)	50 (70)	50 (70)	50 (70)	45 (55)	40 (60)	20 (50)	40 (60)
Hamlin silt loam ¹⁰	60	70	30	40	40	40	40	70	25	30	40
Ringer fine sandy loam	30 (50)	30 (60)	30 (50)	30 (50)	30 (60)	30 (60)	30 (60)	10 (45)	30 (50)	30 (50)	40 (60)
Alton coarse sandy loam	20 (40)	20 (40)	20 (50)	30 (50)	30 (50)	30 (50)	30 (50)	25 (35)	30 (50)	30 (50)	40 (60)
Berrien loamy fine sand	30 (50)	30 (50)	30 (50)	30 (50)	30 (40)	30 (40)	30 (40)	10 (45)	30 (50)	30 (50)	40 (60)
Cowcreek silt loam, drained	50 (80)	50 (70)	40 (50)	50 (70)	60 (80)	60 (80)	60 (80)	50 (70)	30 (50)	30 (50)	40 (60)
Cowcreek fine sandy loam, drained	50 (80)	50 (70)	30 (50)	40 (60)	40 (70)	40 (70)	40 (70)	50 (70)	30 (50)	30 (50)	40 (70)

Hilton silt loam, heavy-subsoil phase	30 (30)	40 (60)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)	140 (300)	150 (350)
Groton gravelly loam	30 (30)	30 (30)	30 (50)	40 (60)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Berrien loamy fine sand, shallow phase	20 (60)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)
Lyons loam, drained	30 (50)	40 (60)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)	140 (300)	150 (350)
Elktoe silt loam, drained	30 (50)	40 (60)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)	140 (300)	150 (350)
Collamer silt loam, poorly drained phase, drained	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)
Schobiehale silty clay loam	30 (50)	30 (50)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Fulton silty clay loam	20 (40)	20 (40)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Mental silt loam	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)	30 (50)
Hilton silt loam, shallow phase	30 (50)	40 (60)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)	140 (300)	150 (350)
Lyons silt loam, drained	30 (50)	40 (60)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)	140 (300)	150 (350)
Poygan silt loam, drained	30 (50)	30 (50)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Granby loamy fine sand, loamy	30 (50)	30 (50)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Petoskey fine sandy loam	20 (40)	20 (40)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Farmington loam	30 (40)	40 (50)	50 (60)	60 (70)	70 (80)	80 (90)	90 (100)	100 (110)	110 (120)	120 (130)	130 (140)	140 (150)	150 (160)
Olivville gravelly loam	20 (40)	20 (40)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Poygan silty clay loam, better drained areas	20 (30)	30 (30)	40 (40)	50 (50)	60 (60)	70 (70)	80 (80)	90 (90)	100 (100)	110 (110)	120 (120)	130 (130)	140 (140)
Lockport silty clay loam	20 (30)	30 (30)	40 (40)	50 (50)	60 (60)	70 (70)	80 (80)	90 (90)	100 (100)	110 (110)	120 (120)	130 (130)	140 (140)
Eel silt loam	40	70	70	70	70	70	70	70	70	70	70	70	70
Granby loamy fine sand, drained	30 (50)	30 (50)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Muck, drained	30 (50)	30 (50)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Waukeon fine sandy loam, better drained areas	30 (50)	30 (50)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Edwards muck, drained	30 (50)	30 (50)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Muck, shallow phase, drained	30 (50)	30 (50)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Hilton loam, poorly drained phase, better drained areas	30 (50)	30 (50)	30 (50)	40 (50)	50 (70)	60 (80)	70 (90)	80 (100)	90 (120)	100 (150)	110 (170)	120 (200)	130 (250)
Collamer silt loam, poorly drained phase, undrained	10	10	10	20	40	40	40	40	40	40	40	40	40

¹ The productivity of each of the various soil types for each specific crop is compared to a standard—100—which stands for 100 acres of wheat for the United States for that crop. Figures without parentheses indicate the productivity under current practices which include the use of soil amendments, whereas figures in parentheses indicate the productivity under current practices which include the use of soil amendments and concentrated feeds not grown on the land.

² Soils are listed in the approximate order of their general productivity under current practices, the most productive first.

average of the crop indexes.

³ Vegetables doing best on highly organic soils, e. g.—onions, celery, lettuce.

⁴ Vegetables not requiring highly organic soils.

⁵ These indexes for fruits (and for vegetables) are largely competitive for the soil types of this and adjoining counties. Although data are used here in reference to the standard—100=200 bushels—it is believed that they are fairly comparable. Although these ratings are not based strictly on the standard—100=100 cow-acres-days—it is believed they are fairly comparable to the number of animal units carried per acre multiplied by the number of animal units per acre for 360 days of the year rates 360, whereas carrying capacity of pasture land. As used here, it is the product of the number of animal units carried per acre multiplied by the number of animal units per acre for 360 days of the year rates 360, whereas injury to the pasture. For example, a soil type able to support 1 animal unit for 360 days of the year rates 360, whereas for 180 days of the year rates 90. Again, if 4 acres of pasture support 1 animal unit for 100 days the rating is 25.

⁶ General farmland as used here, refers to the production of wheat in conjunction with the growing of hay, oats, and silage corn, relatively small acreage may be used also for growing cash crops, such as, peaches, fruits, and vegetables.

⁷ Honeylocust silt loam does not grow so well in Orteens County as it does in counties further east, where it is more typically found.

⁸ These indexes refer to peaches and cherries rather than apples.

⁹ No ratings are given for the protected condition, as these soils are commonly subject to overflow.

¹⁰ These indexes refer to pears instead of apples.

TABLE 6.—*Productivity ratings of soils in Orleans County, N. Y.—Continued*

Soil	Crop-productivity index for—						
	Corn (grain)	Corn (sil- lage)	Wheat	Oats	Timo- thy hay	Red silo clover	A ^b - silo clover
Wolcottsburg silt loam.....	40				60	40	40
Lyons loam, undrained.....					40	40	40
Lyons silt loam, undrained.....					40	40	40
Toledo silt loam, undrained.....					40	40	40
Poygan silt loam, undrained.....					40	40	40
Poygan silty clay loam, undrained.....					40	40	40
Calwood silt loam, undrained.....					40	30	30
Cohrood (no study loam, undrained.....					40	40	40
Toledo silty clay loam.....					40	30	30
Lyons silt loam, shallow phase.....					30	30	30
Brockport silt loam, imperfectly drained, phase.....					30	30	30
Hilton loam, poorly drained, phase, undrained.....					30	30	30
Granby loamy fine sand, undrained— Waukesha fine sandy loam, un- drained.....					20(30)	20(30)	20(30)
Fel silt loam, shallow phase.....							
Warland silty clay loam.....							
Bea loam.....							
Lockport silty clay loam, poorly drained phase.....							
Muck, undrained.....							
Muck, shallow phase, undrained.....							
Edwards muck, undrained.....							
Peat.....							
Marsh.....							

Note.—Leaders, according to position, indicate either that the crop is not commonly grown because of poor adaptation, or that

The use of manure produced from feed grown on the land is not considered an amendment. These indexes may differ from county to county inasmuch as practices of management and certain characteristics of soil types may vary from county to county. Under the current practices of the average to better-than-average farmer in Orleans County, present productivity is generally higher than the inherent productivity which has been defined as the production near or at the level existing when the virgin soil became adjusted to tillage practices. Productivity without the use of amendments on land that never has been benefited by amendments naturally is lower than the inherent productivity. Lacking specific yield data, all the indexes are to be accepted only as the best approximations available at present.

The factors influencing the productivity of land are mainly those of climate, soil, including drainage and relief, or lay of the land, and management. Low ratings for a particular crop may as likely be due to an unfavorable climate or to unsuitable slope conditions as to lack of fertility in the soil. As long-time crop yields furnish the best available summation of the factors contributing to soil productivity, they have been made the basis, so far as such information is available, for the determination of the indexes.

In instances of soils, parts of which have been artificially drained, ratings are given for both the drained and undrained condition. The cost or difficulty of providing drainage plays no part in the productivity rating of such land. Two soils having the same productivity when drained are rated the same, although adequate artificial drainage may cost 10 times as much on one as on the other. The drainage considered for these ratings, however, is that provided in practice in this county and is not optimum. Optimum drainage would change the ratings of some of the soils in the county. In certain instances a lack of information may preclude the giving of any rating other than for the natural conditions.

Because of a lack of definite information and yield data, the indexes in this table for apples, peaches, pears, vegetables, and pasture do not refer absolutely to yield standards. It is believed, however, that the indexes for apples and pasture are fairly comparable to the respective standards.

The soils are listed in the order of their general productivity under current practices as determined largely by the weighted average of the crop index figures in parentheses. The weighted average has been based largely on the areal extent of the individual crops in the county, although in some instances the comparative acre values have been allowed to carry some influence. The importance of fruit-growing results in certain of the lighter-textured soils that are well suited to fruit, such as the Arkport, Alton, and Berrien, receiving higher general productivity ratings in this county than they or similar soils receive in other counties where the hays and grains are relatively more important. The importance of fruit also results in the Genesee and Hamlin soils receiving a lower general productivity rating or grade under current practices than they receive in most other counties. In this way, differences among counties are brought out by the productivity ratings. The weights in percentage that were given to each crop index to arrive at the general productivity rating were as follows:

Corn (grain)	3
Corn (silage)	3
Wheat	12
Oats	8
Timothy hay	15
Red clover or alsike	8
Alfalfa	3
Beans	5
Potatoes	4
Cabbage	2
Tomatoes	2
Vegetables	10
Fruit	20
Pasture	5
	100

Productivity tables do not present the relative roles which soil types, because of their extent and the pattern of their distribution, play in the agriculture of a county. The tables give a qualitative characterization to the productivity of individual soil types. They cannot picture the quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types devoted to each of the specified crops. It must be stated clearly that these productivity ratings are not to be interpreted directly into specific land values. Table 6 is not based upon enough of the factors which influence land values to warrant such an interpretation. The ratings are based on the essentially permanent factors of productivity of the soils and their responsiveness to management, and little attention has been given to the more transitory economic conditions of land values.

AGRICULTURAL INDUSTRIES

The northern part of Orleans County is included in a belt of land bordering Lake Ontario and extending through several counties, that is intensively developed for the production of fruit; and fruit growing in this county is the principal source of agricultural income. Although the industry has been retarded somewhat by competition from other fruit belts, depressing economic conditions, and decreased production, it still remains the farm industry on which a large part of the population depends for a livelihood. Large and small commercial orchards are well distributed, principally in the section north of the "million-dollar highway."

Actual production or growing of fruit requires the labor of a large number of farm owners, tenants, laborers, and special help during the harvesting period. Changes in economic conditions have caused some curtailment of operations, but the large investment of capital in orchards, storage plants, and facilities for marketing fruit demand the continuance and maintenance of this industry. Many of the fruit growers are specialists and produce high-quality fruit that meets with market requirements and public favor.

Competition from other fruit-growing sections outside the State has compelled growers to improve producing, grading, and marketing methods. Improvement in the quality and character of pack has received some consideration, and a general trend away from the barrel pack and toward basket, box, and fancy containers is resulting.

With the gradual development and expansion of fruit production in this county, subsidiary and related pursuits sprang up, and the whole expanded into a large business. Cooperative and private organizations have been established in various communities throughout the fruit area for storing, grading, and marketing fruit. The storage plants and receiving stations have been strategically placed along lines of communication and railroads in all the towns and community centers. In addition, the various organizations buy or manufacture supplies and equipment required by the fruit farmers. Stave, cooperage, and other plants furnish or produce containers, barrels, baskets, liners, and tops for packing the fruit.

Although many of the organizations in the various centers deal primarily with the storage, handling, and marketing of fruit, some are established for producing byproducts. Evaporators for drying apples, cider mills, and canneries give seasonal employment. A large apple-sauce factory, that annually handles a large tonnage of apples, is located at Lyndonville; a cider mill of large capacity is at Holley; and other mills for neighboring trade are located in a number of places throughout the county.

Although the production of apples forms the major part of the fruit industry, distributing agencies are well equipped to handle and market all other fruits grown for sale. Most of the fruit is marketed through the organizations now existing within the county for its distribution, but some farmers truck a part of their fruit to the open market in Rochester, Buffalo, and other centers of population. Roadside fruit stands are common along the main paved highways. This method of reaching the public is popular with some farmers who cater to the numerous tourists and others. The various towns and trading centers within the county offer only a limited market for fruit, and the more favored and popular markets are outside the county and in other States. Much of the apple crop reaches European markets.

The growing of vegetables, common in all sections, is an adjunct to other farming enterprises and has been developed through the establishment of canning factories in the larger towns. Contracts are made with farmers to grow the vegetables desired by the canning companies. Peas, tomatoes, beans, and sweet corn are the main crops used by the canneries. Pea vineyards are located in different sections for the purpose of shelling the peas which are then trucked immediately to a canning factory to be packed. One of the largest canning plants in the State is located at Albion. Although the canning of vegetables is seasonal, it provides work, throughout the canning period, to a large number of people.

Dairying has become well established on a number of farms. Although it is more or less supplementary to other farming operations in the northern part of the county, in the southern part the system of farming practiced is one that supports dairying as the chief enterprise. The land is suitable for producing grain, forage, and pasture crops—the necessary feeds for cattle—and thus the quantity of concentrated feed purchased is reduced. The nearby large centers of population—Rochester, Buffalo, New York, and other cities—furnish desirable markets for raw milk, cream, and other dairy products.

The agricultural industries also include the feeding of livestock, which is one of the minor occupations of the farmers but of local importance in some sections. On the livestock farms, the hay, corn, and other feed, instead of being sold directly, are used for the fattening of cattle during the winter. Some townships include a large area of land which, because of drainage conditions, is not entirely suitable for cultivation, and the farmers, instead of allowing such land to remain idle, use it to a large extent for pasturing beef cattle or sheep. The importance of the livestock industry is indicated by the number of animals on the farms. The census of 1930 reports 13,372 head of cattle valued at \$929,708; 56,012 sheep valued at \$487,061; and 5,870 swine valued at \$83,496. The numbers reported by the 1935 census are 12,271, 38,231, and 4,432 head, respectively.

MORPHOLOGY AND GENESIS OF SOILS

The material from which the soils of Orleans County had their genesis can be traced back to the Pleistocene (glacial) epoch. The concerted activities of ice sheets and water, during this time, deposited and accumulated silts, clays, sands, and rock fragments in an intricate, complicated mixture. Subsequent weathering and other soil-producing agencies that acted or impressed their influences on these various materials, developed the soils that now occupy the county. They form a part of the group of Gray-Brown Podzolic soils that have developed in the temperate climatic section of eastern United States.

Following the retreat of the ice to the north, the glacial drift and water-laid deposits were encroached on and covered with a growth of mixed hardwoods and an intermingling of conifers, chiefly hemlock and white pine. Soil materials developed under this type of vegetation did not accumulate much organic matter. The quantity of organic matter incorporated with the soil differs with the character of the drainage. Soils having inadequate circulation of ground water are darker colored and contain larger quantities of vegetable matter than soils occupying well-drained sites; and well-aerated soils have a contrastingly lighter color.

The soils range from sand to silty clay loam and clay in texture, and they differ in consistence, structure, moisture relationships, chemical composition, and natural fertility. The various degrees of development in the soil material are characterized by abrupt changes within short distances. The parent soil material consists of the products of glaciation. A great quantity of the glacial debris was moved only short distances by glacial forces, and in many parts of the county the soil material shows some relationship to the underlying rocks, but some of the glacial detritus was brought in from distant points and modified that from local formations.

The geologic rock strata are horizontally bedded with a slight dip southward. They are indurated sediments deposited during the Silurian period. Beginning at Lake Ontario, along the northern boundary of the county, the first rocks exposed belong to the Medina series. The shale member is termed Queenstown and consists of red shale, together with some benches of argillaceous sandstone which is dominantly red but includes gray and olive variegations. The shale dis-

integrates rapidly on exposure. This formation extends from 7 to 9 miles south of the lake. The next higher formation is the Clinton, consisting of interbedded shales, sandstone, and limestone, which occurs in a belt ranging from 1 to 3 miles in width. Resting on this is the Niagara which comprises gray dolomitic limestone and thin-bedded shales. In the vicinity of Clarendon, the limestone stands out as a prominent ridge or escarpment.

The influences of materials derived from these various formations are made evident in the different soil belts developed in the county. The red colors characterizing the Clarkson and Hilton soils are not the results, primarily, of oxidation of soil material but are influenced by decomposition of the red shale and sandstone they contain. The Brockport soils are the weathered products of materials originating in the heavy calcareous shales above the Medina sandstone. Farther south on the higher elevations, where the impure limestone members of the Niagara occur, the color, texture, structure, and degree of calcareousness of the soils are markedly different from these features in the belts farther north. The Ontario, Cazenovia, and Honeoye soils are dominated by the weathered limestone and in general are more calcareous than the soils farther north.

In addition to the mixing of materials by ice action, deposits were made by glacial lake waters. The northern part of the county was occupied by glacial Lake Iroquois which extended from the present level of Lake Ontario southward 6 or 8 miles to the ridge. This ridge is a conspicuous well-defined beach line marking one limit of the glacial lake and extending across Orleans County into adjoining counties. Sediments laid down in the section covered by the lake included materials ranging from medium sand to clay. After assorting and bedding of the material was accomplished, some modification resulted in a few sections where the stratified materials were re-worked by ice action, producing intricate patterns in the soil materials. In general, the finer materials occupy a belt several miles wide bordering the lake, and the coarser or sandy materials occur in an east-and-west belt just south of the first belt. The sediments were derived mainly from sandstones and shales of local origin.

The finer materials have given rise to the Dunkirk, Fulton, and Toledo soils, and most of the sandy materials are classified with the Berrien, Granby, Rimer, and Arkport soils. Water-laid materials in the southern part of the county, largely of limestone origin, gave rise to the Poygan and Schoharie soils.

The soil-forming agencies, operating on the complex materials covering the county, have been more or less restricted by drainage which, as a whole, is immaturely developed, and a large land area in the southern part has poor or no natural drainage. In many places, thoroughness of drainage is not correlated so much with relief as it is with the character of the soil materials and the underlying strata. As a consequence of drainage, two broad groups of soils have developed. Those soils that have well-defined layers, as regards color, texture, and structure, occur only in areas having good drainage, whereas lack of uniformity characterizes those soils lacking good aeration, oxidation, and drainage. The well-drained soils exhibit most notably the characteristics of the Gray-Brown Podzolic soils.

Leaching of soluble elements and the associated translocation of soil particles to lower parts of the soil are the dominant soil-forming processes. In the process of leaching, some calcium and magnesium carbonates and sesquioxides have been removed.

The generalized profile of well-drained soils, in an undisturbed state, shows the following layers: (1) A thin layer of litter and forest mold, (2) a dark grayish-brown humous layer, (3) grayish-brown or brownish-gray material, (4) an irregular leached gray layer, (5) a layer of maximum intensity of coloring from ferric oxide and concentration of clay, and (6) the partly weathered or unweathered parent material or geologic substratum.

The well-drained soils are further divided into subgroups, according to the texture and structure of the subsoil and substratum—one division including those soils that have friable pervious lower layers, and another division including those soils having lower layers sufficiently heavy or compact to restrict downward percolation of water, or which are only moderately pervious.

The Ontario soils are characteristic of the first subgroup. They are the most extensive and the most widely distributed soils in the southern part of the county, where they occupy undulating or gently rolling areas. The soil materials are derived to a large extent from underlying impure limerocks. The materials of the soil layers are friable and pervious, and lime salts have been leached to the lower part of the B horizon. Originally these soils were forested, mainly to hardwoods, but now, with the exception of an occasional wood lot, they are used for some form of farm activity.

Following is a description of a profile of Ontario loam, the principal member of the Ontario series, as observed in a hayfield about one-fourth mile east of East Shelby:

- A. 0 to 7 inches, grayish-brown friable loam of vesicular structure. The upper part is several shades darker than the lower part, owing to a slightly higher content of well-decomposed organic matter.
- A. 7 to 16 inches, light-brown slightly heavier loam which has a lighter color than the surface soil and contains less organic matter. The material has a feeble crumblike structure. The individual fragments are about the size of buckshot, and under pressure they break down into structureless material.
- B. 16 to 27 inches, deep-brown or light reddish-brown light clay loam which has developed faint compaction, but when disturbed is friable and pervious. When moist, it has a faint-red cast which is not readily apparent when the material is dry. On drying, the material breaks to a mass of angular clods ranging from about one-eighth to three-fourths inch in diameter. The faces of the individual aggregates have a very thin coating of rich-brown material, whereas the interiors are lighter brown. The hydrogen-ion concentration, determined colorimetrically, indicates neutrality, as no effervescence from carbonates with cold hydrochloric acid was observable.
- C. 27 to 50 inches, light grayish-brown friable unassorted silt, loam, and fine sandy loam material which is moderately calcareous.

The soil is appreciably deeper colored and contains a higher percentage of clay in the B horizon than in the other layers. It also contains some flat, angular, and rounded cobbles, gravel, and small boulders of limestone, sandstone, and shales, together with a few igneous stone fragments. Some materials from the Medina and Queenstown formations are present, but most of the stony material is from Clinton and Niagara rock strata. Other soils of the Ontario series are included with Ontario fine sandy loam.

The Cazenovia soils are closely related to the Ontario soils in texture and structure, but they are characterized by a browner A horizon and a richer colored B horizon. Distinguishing features are the larger quantity of limestone and the more calcareous character of the Cazenovia soils.

The Honeoye soils are similar in color to the Ontario soils, but they are lighter textured in the B horizon, more compact in the C horizon, and, in addition, are underlain by limestone formations within a depth ranging from 5 to 10 feet. Shallow deposits of brown material on limestone at a depth of less than 40 inches are classified with the Farmington soils.

Associated with the Ontario soils are areas of soils, in which normal weathering has been slightly retarded, owing to less perfect drainage. They have similar textural layers, but the A horizon is more gray and the lower 2 or 3 inches of material resting on the B horizon is leached and consists of light-gray or grayish-yellow material. The material in the B horizon shows sufficient compaction somewhat to impede downward percolation of moisture. As a result, the lower part of the A horizon has been subject to a water table for sufficient time to have some of the soluble elements removed by soil water. Such conditions have produced the Hilton soils.

Other soils, strongly influenced by calcareous material are the Brockport soils which are derived largely from decomposed calcareous shale and are only slightly modified by inclusions of other materials. They occupy a position between the higher limestone soils just described and the lower lying soils to the north. Owing to the influence of the weathered shale, these soils have a large content of clay which produces a heavier texture than occurs in any limestone soil developed on till. Brockport silt loam is characterized by a grayish-brown moderately heavy surface layer and a lighter colored subsurface layer. The B horizon is brown or light reddish-brown heavy tight clayey clay faintly stained with dull shades of brown. The C horizon consists of unassorted silts and clays containing a high proportion of shale and fine-grained sandstone. This soil is not so well oxidized as are the included gravelly areas, in which the A horizon is more gray and thinner, the B horizon is dull-brown or dull brownish-gray heavier tighter clay mottled with rust brown and gray, and the substratum is composed mainly of gray heavy tight clay that is largely residual from the underlying shale. In most places, the shale rock occurs at a depth ranging from 4 to 5 feet. Soils such as the Brockport are members of the second division of this group.

The same general profile development as that elsewhere is impressed on well-oxidized and well-aerated soils in the northern section of the county, but differences of color, consistence, and origin occur. Clarkson loam is typical of the mature profile for this section. Following is a description of a profile of this soil, as observed in an orchard about 3 miles northeast of Albion:

- A₁. 0 to 7 inches, grayish-brown gritty light loam which is friable, pervious, and readily absorbs and retains soil moisture.
- A₂. 7 to 13 inches, light-brown coherent friable loam which is permeable and easily penetrated by moisture and plant roots. Filled tunnels and cavities formed by worms and burrowing insects or animals are darker than the mass of the material. Small roots, about which cling some dark-colored soil, are abundant.

- A. 13 to 16 inches, coherent light loam having a combination of light-gray and grayish-yellow colors with an irregular but moderate staining of rust yellow. The gray part contains few or no mottles. The material in this layer contains small aggregations of rust-colored material feebly bound together by iron compounds.
- B. 16 to 25 inches, bright reddish-brown or light brownish-red light clay loam which has developed faint compaction in places in the upper part but is more friable in the lower part. The material in this layer breaks into angular irregularly shaped structure particles that show little or no change in color when crushed. When moist, the material has a red tinge. It contains several lenses of smooth reddish-brown heavy clay around masses of red shale. The material in this layer has a slightly acid reaction.
- C. 25 to 38 inches, light reddish-brown friable unassorted fine sandy loam and loam material which is alkaline in reaction.

Small boulders, cobbles, and flat subangular stones form a part of the material of the several layers. The fragments are largely of Medina sandstone and Queenstown shale, that form the rock plain underlying the soil, and they also include a few crystalline and igneous rocks. Clarkson fine sandy loam differs in texture of the surface soil, but the lower layers are like Clarkson loam.

In general, these soils are not so calcareous as those in the southern part of the county. The red shades are largely the same as those of the decayed red sandstone and shale fragments. A distinctive part of the profile is the irregular gray layer formed on top of the B horizon.

Some areas of soil mapped in this county bear a relationship to Clarkson loam, but the materials that compose them have been modified by water action. They have been classed as Dunkirk gravelly loam which has developed largely on partly weathered red sandstone and shale. This soil has a medium dark-brown friable surface soil underlain by a lighter brown subsurface layer of similar texture and structure. The B horizon is very thick, ranging from about 12 to 35 inches in thickness, and consists of reddish-brown compact gravelly and cobbly clay loam. It is underlain by stratified layers of buff, brown, or grayish-brown silt loam, fine sandy loam, and other materials.

Bordering Lake Ontario is a belt of soils that occupy a series of smooth or flat-topped ridges. In these soils, which are classified as Dunkirk silt loam, the water table lies at too great a depth to hinder the normal process of weathering. Following is a description of a profile of Dunkirk silt loam as observed in a 30-year-old apple orchard about 1½ miles east of Kuckville:

- 1. 0 to 6 inches, grayish-brown and brown mellow smooth silt loam of vesicular structure, containing very little gritty material. The upper part of this layer is slightly darker than the lower part, owing to the greater content of organic matter.
- 2. 6 to 13 inches, light-brown or yellowish-brown slightly heavier silt loam having a thin platy or laminated structure. The fragmental particles are fragile and break readily to a structureless mass.
- 3. 13 to 15 inches, faintly compact but friable mixed brownish-yellow and dull-gray silt loam stained with light gray and rust yellow.
- 4. 15 to 27 inches, buff or light reddish-brown tight moderately heavy blocky clay having a feebly columnar structure. Along fracture joints and root channels are thin seams or streaks of gray and dull-yellow material. Breakage planes are coated with a slick reddish-brown film. When crushed, the fragments show a somewhat brown waxy luster. They contain no grit. A few worm casts and plant roots are most noticeable along fracture planes.

5. 27 to 50 inches, brown slightly compact thinly bedded layers of silt loam and very fine sandy loam, with a few included layers of reddish-brown calcareous clay. Between the bedded layers are thin seams of rust-colored material.

Light-gray streaks of lime compounds extend through the lower part of the profile, and secondary lime, in the form of nodules, is scattered in the lower part of layer 5. The average depth of the carbonate zone is about 25 inches below the surface. The translocation of finely divided material from the upper to the lower layers has produced a tight structure in layer 4, the movement of material probably having been aided by small quantities of deflocculating salts.

Dunkirk silt loam is the dominant type of the Dunkirk series, and other members mapped are the fine sandy loam, loam, and gravelly loam, separations into these types being made primarily on the texture of the surface soil.

The important well-drained sandy soils are included in the Petoskey, Alton, Groton, and Arkport series.

The Alton soils have brown or yellowish-brown sandy A₁ layers and yellow fairly incoherent sandy A₂ layers. The brown B horizon is only faintly developed and includes loamy material weathered from the underlying gravel. The mixture of sand and clay composing this horizon is slightly cemented by colloidal matter into an irregular layer ranging from 2 to 5 inches in thickness. The parent material is composed of gray calcareous stratified gravel and sand. These soils are well aerated and inclined to be droughty, and they occupy smooth or undulating areas. The Groton soils are similar in development but are confined to a kame and esker type of relief. The Arkport soils have light-brown sandy surface soils, containing a small admixture of organic matter, overlying lighter colored sandy material that contains little binding substance. The B horizon consists of brown fine sandy material, in which pockets, lenses, or strata of a characteristically cemented reddish-brown heavy fine sandy loam material are included. The Petoskey soils are fine-textured sandy materials. The relief ranges from smooth to strongly undulating. The color profile is fairly well developed, but the texture profile is only feebly developed.

Intermingling with and forming a patchy arrangement within and around the different well-defined maturely weathered soils are soil materials which are restricted from normal development, owing to excess moisture and lack of aeration. They form a considerable part of the total area of the county. Topographic positions favoring the accumulation of drainage from higher elevations, together with the natural structural characteristics of the materials, have resulted in saturation or waterlogging. These soils have a fairly wide range in the extent to which the materials are affected by ground water, and this is reflected in the degree of weathering of the different soils. They have a trend toward the formation of A and B horizons, but they are characterized by many variations of color and structure. Various quantities of decayed organic matter have been incorporated in the upper part of the soil profile and have imparted dark color shades to the mineral material, and this influence is noticeable to a depth ranging from 10 to 15 inches.

A characteristic of all poorly drained soils, regardless of texture or structure, is a 1- to 5-inch gray layer in the lower part of the A horizon. In soils of heavy texture it occupies an irregular horizontal stratum above the compact tight, or hardpan, layer of the profile, and in sandy soils, or materials of porous open structure, it is formed at the top of the water table. The material in this layer, as a consequence of prolonged saturation, has been leached of a large proportion of its color and soluble constituents. The material in the immature B layer is characterized by differences of texture, compactness, and structure. These differences divide the poorly drained soils into two subgroups—a subgroup having slowly pervious horizons and one having moderately friable and pervious horizons.

The Toledo soils are an example of the first subgroup. They comprise soils that are poorly drained equivalents of the Dunkirk soils. They contain sufficient organic matter to impart a dark color to the surface layers. They are developed in association with the Dunkirk soils and occupy positions favorable for receiving and retaining seepage waters. Soil materials intermediate in drainage and development between the Dunkirk and Toledo soils are classified as Lucas soils. The Collamer soils, in color and drainage development, are similar to the Lucas soils, but they differ in texture. The Collamer soils are composed dominantly of silty layers instead of clay that is characteristic of the Lucas soils. The Poygan soils have brownish-gray or nearly black surface soils of heavy texture, underlain by a mottled gray upper subsoil layer and a reddish-brown or pinkish-brown heavy lower subsoil layer. These soils occur only in the southern part of the county and are derived largely from limestone.

The Lyons soils are composed of materials such as develop into Ontario soils when maturely weathered, but are poorly drained and hence have dark-colored surface soils and mottled subsoils.

In the northern part of the county is a large area of glacial-till materials having inadequate drainage, which are underlain by red sandstone and shale formations and are influenced by them. They are related to the Clarkson soils, but weathering agencies have been retarded by excess water, and they show immature development. Such soils have been correlated as Hilton loam and its poorly drained phase. The poorly drained areas are darker in the surface layer and are more leached of color in the lower layers than the typical Hilton soil, but both have a light-gray layer resting on a compact slowly pervious subsoil.

Imperfectly to poorly drained soils that have moderately friable and pervious A and B horizons are mainly sandy. Their separations are based largely on degree of drainage, color, and content of organic matter. They have a moderately high water table, and some parts of the substrata are saturated.

The Berrien soils are the most extensive within this subgroup. These soils have medium or very fine textured sandy brownish-gray or dark grayish-brown surface soils that grade at a slight depth into lighter, varicolored sandy layers. Small aggregates of the sandy materials are bound together by iron compounds and colloidal matter. The relief may be ridgy, undulating, or smooth, and, because of this unevenness, the height of the water table affects the material at different depths from the surface. Tests by the La Motte

method indicate slight acidity to a depth ranging from 20 to about 35 inches.

The Granby soils are less advanced in development than the Berrien soils. They are derived from similar materials but have been influenced by a higher water table. They are darker in the surface soils than the Berrien soils.

Colwood fine sandy loam superficially resembles Granby loamy fine sand in color and texture of the surface soil and upper part of the subsoil, but the lower part of the subsoil is more compact and contains small lenses of cemented heavy fine sandy loam or sandy clay loam. The sandy substratum is strongly compact in place and is intricately mottled with gray, yellow, and pinkish gray. Colwood silt loam occupies a drainage position similar to that of Granby loamy fine sand, but it differs from that soil in that it has a darker and thicker surface layer and is somewhat heavier in texture. The underlying layers are mottled gray silts, sands, and clays, the sands predominating.

The Rimer soils are closely related to the Berrien soils. The upper part of the profile is similar in color and texture, but the sandy part of the Rimer soils is underlain, at an average depth of about 30 inches, by slowly pervious heavy calcareous clay. In like manner, the Granby soils bear a resemblance to the Wauseon soils in the upper part of the profile, but the Wauseon soils are underlain by a clay stratum like that under the Rimer soils.

Organic soils, composed of vegetable matter in various stages of decomposition, have accumulated, for the most part, in former lakes. The deposits range in thickness from a few inches to about 15 feet, but the more common thickness is between 20 and 50 inches. The organic matter may be black well-decomposed material classed as muck or brown fibrous only slightly decayed material termed peat. The organic material contains some admixture of mineral matter, but the percentage of combustible material is probably in excess of 70 percent. The organic soils are separated into types on the basis of the thickness of the vegetable matter and the character of the underlying mineral layers.

The alluvium of this county, which is mainly local in origin, occurs only in comparatively narrow strips along streams and comprises but a small proportion of the total area. Owing to its recent deposition and disturbance by periodic overflow, no definite profile has developed. The well-drained brownish-red or reddish-brown sediments are classed in the Hamlin series of soils, and the well-drained brown material in the Genesee series. The poorly drained soils are correlated in the Wayland and Eel series, the Eel soils representing an intermediate condition of drainage.

SUMMARY

Orleans County comprises an important agricultural unit in the up-State section of New York. It occupies an excellent location along Lake Ontario for diverse farming operations and the marketing of crops. The lay of the land, or relief, is entirely suitable for cultivation of the crops grown and for the use of mechanical farm implements.

In general, three land divisions extend across the county: A lake-plain division, occupying the northern part, is characterized by flat or gently undulating relief and extends to the ridge road which marks the location of an old beach line of a former glacial lake; south of the ridge the land gradually rises to a gently undulating higher plain; and the southern part is covered by the highest plain in the county, consisting of a belt of undulating or gently rolling land with some intrusions of flat lake-plain bodies.

About 90 percent of the land is cleared of its original forest growth, and the present tree growth, including elm, maple, oaks, hickory, and ash, is confined principally to farm wood lots of moderate size. Approximately 85 percent of the land area is divided among 2,608 farms.

Climate has been an important factor in the development of the agricultural activities of this section. The ameliorating effect of Lake Ontario in modifying the temperature has been of great significance in special farm pursuits. The growing season is longer here than in counties farther south. The slowness of temperature changes in the vicinity of Lake Ontario lessens danger from early fall frosts and the hazards of late spring frosts. The average length of the frost-free season is 164 days in the northern part and slightly less in the southern part of the county. The average annual precipitation is nearly 32 inches.

Agriculture is the main activity, and ample transportation facilities are available for marketing the crops. Contacts with outside markets are quickly and readily made via the New York Central Railroad which operates two branches through the county, connecting the important towns and villages. In addition, good paved highways lead to local and nearby markets. Automobile freight lines and trucks afford quick daily service to shipping stations and marketing points. Buffalo and Rochester serve as centers for the shipping of farm products to various parts of the United States and to foreign countries.

The soils are notable for their diversity, number, and change from one kind to another within short distances. The materials from which they have developed had their origin during glacial times. Unconsolidated clays, sands, silts, rock fragments, and gravel were accumulated by agencies of ice and water, were mixed, or assorted and distributed as a deep mantle over underlying rock formations. The greater part of the northern half of the county consists of water-laid sediments, some of which were laid down with little degree of uniformity, and the various kinds of materials are intermixed and bedded in complicated layers.

The glacial till distributed over the county is composed principally of unassorted fine- and coarse-textured soil particles. Much of the soil material was moved but a short distance and includes fragmental matter derived from different rock formations underlying the area.

Physical and chemical activities operating on these various kinds of materials developed the present soils which are the results of soil-forming processes. The soils of this county form a part of a larger belt of soils that cover much of eastern United States, and they constitute a part of the group of Gray-Brown Podzolic soils.

Leaching is a dominant development process in the soils of this group, which tends to remove materials and elements essential for the normal growth of plants, from the upper soil layers to lower layers. The productive capacity of a soil is influenced to a considerable extent by the degree of leaching. Leaching is pronounced in well-drained soils but is restricted in poorly drained ones, so that soils occupying well-drained situations are subject to removal of organic matter, with its important constituent, nitrogen, and mineral compounds.

The soils that have been subjected to these activities are classed with the Ontario, Dunkirk, Honeoye, Clarkson, Cazenovia, Arkport, Groton, Alton, Lucas, and Schoharie series. The Ontario, Honeoye, and Cazenovia soils are influenced by limestone and have friable subsoils. The Groton, Alton, Dunkirk, and Arkport soils are loamy or light-textured soils with pervious subsoils. The Lucas and Schoharie soils are characterized by tight heavy subsoils and are the inherently less fertile soils of the county, but they are made productive through good management and proper crop rotations.

Numerous poorly drained soils form an intricate network in association with the well-drained soils. They occupy flats, depressions, and lower slopes that are subject to seepage from higher lying soils and slow circulation of ground water. Owing to their content of organic matter, most of them have dark-colored upper soil layers. The quantity of organic matter incorporated with the mineral matter bears a relationship to the degree of drainage. The dark poorly drained soils are described as members of the Lyons, Poygan, Toledo, Wauseon, Granby, and Colwood series, and muck.

The soils of another group, which aggregate a rather large total area, occupy an intermediate position, as regards fertility and drainage, between the soils of other groups. These soils are correlated as types of the Hilton, Brockport, Collamer, Fulton, Lockport, Berrien, and Rimer series.

Agricultural practices cover a diversity of operations. Fruit growing is the chief enterprise and the source of the largest revenue, and vegetable growing occupies second place. The area devoted to general field crops is greater than the total area in orchards and vegetable crops, but the general crops are mainly subsistence crops and furnish only a small part of the farm income.

The production of apples is the largest branch of fruit growing. Most of the orchards are established in the northern half of the county, and they are planted on a variety of soils and sites. Selection of land for fruit trees has not been altogether a matter of adaptation of the soil to trees, but orchards were established in this section on account of the modifying effect of Lake Ontario on the temperature, thereby prolonging the growing season and eliminating some of the hazards of spring and fall frosts. Large yields of fruit of high quality are produced on deep, well-drained, and well-aerated soils having loamy or silty surface soils and friable or moderately heavy subsoils. Trees planted on inadequately drained land reflect the influence of excessive ground water.

The production of vegetable crops has been induced by the establishment of numerous canning factories, and vegetables for canning are usually grown under contract with the canning companies. Truck

crops for the open market are a specialized type of farming confined chiefly to muck land.

General farming, in conjunction with dairying and some orcharding, is practiced throughout the southern part of the county. Fruit growing is not followed so extensively here as farther north because of the shorter growing season in the section less influenced by Lake Ontario. Practically all the hay, corn, and small grain is fed to the farm livestock and returned to the land in the form of manure. On these farms a large part of the farm revenue is derived from the sale of dairy and poultry products, together with some fruits and vegetables.

This soil survey is a contribution from
BUREAU OF CHEMISTRY AND SOILS

HENRY G. KNIGHT, *Chief*

SOIL SURVEY DIVISION

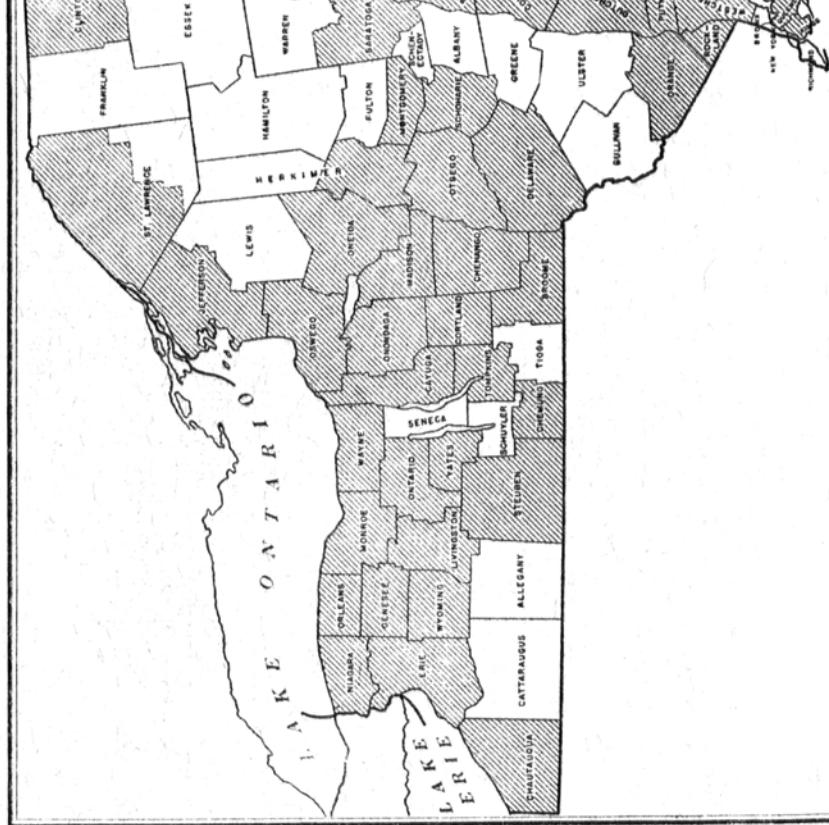
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
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